PATTERNS OF ALCOHOL USE AND HARMS AMONG YOUTH AND CORRELATIONS WITH ALCOHOL POLICIES IN LOW- AND MIDDLE-INCOME COUNTRIES

by

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ABSTRACT

Introduction

Consumption of alcohol by adolescents is of global concern due to the potentially harmful short- and long-term effects of its use on both individuals and society. Alcohol use is the leading risk factor for mortality in 15-24 year olds, yet little is known about consumption patterns, alcohol-related policies, and the correlation with harm in youth in low- and middle-income countries (LMICs).

Methods

Data from LMICs were collected as part of the World Health Organization's Global School-based Student Health Survey (GSHS) between 2010-2015. National samples of 1,119 (Vanuatu) to 28,368 (Argentina) 13-16 year olds were collected through self-administered questionnaires in a classroom setting. Policy data was obtained from the Global Information System on Alcohol and Health. Prevalence of alcohol consumption was evaluated as non-drinking, current drinking without binge, and binge drinking. Logistic regression models were used to assess the correlation between alcohol consumption and past year fighting, serious injury, and four alcohol policies.

Results

Prevalence of current alcohol use ranged from 7.3% in Syria to 55.9% in Jamaica; prevalence of binge alcohol use (of current drinkers) ranged from 3.8% in Ghana and Syria to 35.1% in Argentina. More than 30% of non-drinking students, 52% of current drinkers who did not report binge drinking, and 56% who reported binge drinking reported having been in a physical fight in the past year. Similarly, 44% of non-drinking students, 59% of current drinkers, and 62% of binge drinkers reported having been seriously injured in the past year. More restrictive policies

were inversely correlated with prevalence of current and binge drinking among youth, even after adjusting for age, sex, and country-level income.

Discussion

One in five students in LMICs reported consuming at least one alcoholic beverage in the past month. Young people in LMICs are at great risk of violence and injury, and increasing levels of alcohol consumption increase this risk significantly. Stricter alcohol policies are correlated with lower consumption among youth in LMICs and should be prioritized as interventions to reduce youth alcohol consumption and related harms. Future research should include additional demographic data on students and longitudinal surveys to assess causality and track trends.

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Overview

As of 2016, alcohol use was among the seven leading risk factors for global disease burden, behind high blood pressure, tobacco smoking and exposure to second hand smoke, household air pollution from solid fuels, and a diet low in fruits,[2] and accounted for 3.3 million deaths and 5.1 percent of global disability-adjusted life-years (DALYs).[3] This is a significant shift from 1990, when the top risk factors contributed more heavily to communicable diseases in children rather than non-communicable diseases in adults (i.e., child wasting) and alcohol use was in the 13th highest position.[2] Harm from alcohol use is not distributed equally; although high-income countries (HICs) have much higher levels of consumption, low- and middle-income countries (LMICs) suffer the negative consequences to a significantly greater degree,[4] and alcohol is the single largest behavioral risk factor for morbidity and mortality in most middle-income countries.[5]

Alcohol is a causal or contributing factor in more than 200 diseases and injury conditions such as cirrhosis of the liver, poisonings, and road traffic crashes.[4] Alcohol-related harms occur through a combination of the volume of alcohol consumed and the pattern of consumption (and in a few contexts, the quality); dose-response relationships are seen with many major disease categories (e.g., tuberculosis, certain cancers).[3,6] Patterns such as heavy episodic drinking are linked to a greater risk of intentional and unintentional injuries, violence, and fetal alcohol syndrome; however, increased risk can begin with the first drink for certain outcomes, such as breast cancer and motor vehicle crashes.[7,8]

Children and adolescents are particularly vulnerable to the effects of alcohol because of their smaller stature, lack of tolerance, and inexperience with drinking, but are frequently not

included in studies analyzing consumption patterns, volume, types of beverages consumed, and other epidemiological factors necessary for effective programmatic and policy interventions. Males experience a greater burden of morbidity and mortality, due in part to higher rates of abstention and less harmful patterns of drinking in females.[9,10] Globally, youth aged 10-24 years have a greater burden of alcohol-caused DALYs (7 percent) than other age groups, again with males shouldering the greater burden – alcohol is the leading cause of death and disability for males ages 15-24 in every World Health Organization (WHO) region except the Eastern Mediterranean (EMR). It is also the leading cause of death and disability for females in this age group in HICs and the Region of the Americas (AMR).[11]

Excessive alcohol use has been called a development issue due to its potential negative social impact beyond just the health impact in emerging countries.[12] Industrialization brings more expendable cash for luxuries such as imported processed foods and alcoholic beverages in addition to more time to enjoy such luxuries with a move away from laborious agrarian lifestyles. Alcoholic beverages can be symbols of "cosmopolitism, and on the other hand… national pride."[13, p3-4] Papua New Guinea is one of the least developed countries on the planet, but they have a locally-brewed beer that is warmly referred to as "Our Beer" right on the label, despite being a subsidiary of the Dutch company, Heineken. A healthy workforce is necessary as societies expand, and alcohol use and related harm (such as workplace absenteeism) threaten this, because they tend to increase as development increases.[14,15]

Measuring alcohol use

The dimensions of how people consume alcohol are important to conceptualize and measure to assess morbidity and mortality and other consequences within and across populations. The three main factors include the volume or amount of alcohol consumed, the

pattern or description of how the alcohol is consumed, and to some degree, the quality of the alcohol.

Volume of alcohol consumed in a population is generally measured in two ways, each with notable strengths and weaknesses. Per capita estimates are available from industry sources and can be used to estimate overall consumption in a population.[16] This measure, however, reflects total overall industry sales and may not reflect actual inventory sold at retail or alcohol purchased but not consumed within the time period under review, nor can it account for duty-free sales or alcohol consumed while abroad.[16] Industry sales figures also do not include illicitly or informally produced alcohol, which is more likely to be an issue in developing countries.[3] Volume of alcohol consumption may also be calculated through population-based surveys. Questions that include average quantity consumed in a time period and average frequency of consumption of that quantity are common ("quantity-frequency" or "QF" measure).[17] The U.S. National Survey on Drug Use and Health (NSDUH) conducted by the Substance Abuse and Mental Health Services Administration (SAMHSA) includes a representative sample of the noninstitutionalized US civilian population aged 12 or older.[18] The NSDUH asks, "Think specifically about the past 30 days - that is, since [DATEFILL], up to and including today. During the past 30 days, on how many days did you drink one or more drinks of an alcoholic beverage?" and "On the [ESTIMATE] days that you drank during the past 30 days, how many drinks did you usually have? Count as a drink a can or bottle of beer; a wine cooler or a glass of wine, champagne, or sherry; a shot of liquor or a mixed drink or cocktail." An average volume per respondent may be calculated by multiplying average quantity by average frequency for the time period (here, 30 days). The issue with these questions is that the calculated volume has been found to result in significant underestimates;[19,20] respondents may not accurately recall actual

drinks consumed or may omit drinks consumed on heavy drinking days in the average.[21] The NSDUH (and many other surveys) also asks, "During the past 30 days, that is since [DATEFILL], on how many days did you have 5 or more drinks on the same occasion?" to inquire about episodes of heavy alcohol use. "Binge indexing" is a procedure developed to include heavy drinking days into total consumption estimates from survey data and results in estimates closer to sales figures.[22] Stahre et al. found an almost 42 percent relative increase in prevalence of heavy drinking among U.S. adults (5.7 percent to 8.1 percent) and a 14 percent relative increase in average drinks per day using indexing.[23] Other researchers have developed questionnaires that greatly increase the accuracy of reported alcohol consumption. The New Zealand National Alcohol Survey 2000 captured 94 percent of taxable alcohol sales by asking location-specific questions about quantity and frequency, in addition to container size and brand.[16] A recent nationally representative survey of 13-20 year olds in the U.S. presented respondents with detailed drinking questions including a list of 898 different brands that are widely available; this brand-specific method captured 62 percent more consumption than the standard QF measure in the same survey.[24,25] Surveys may also underreport as they usually do not capture the population in the military, institutionalized, undocumented, those without computers or telephones, or tourists.[26]

Patterns of drinking refer to how people are actually consuming alcohol and have important implications for health risks and other behaviors. Consuming one alcoholic beverage a day for seven days at a meal and consuming all seven beverages at one time once a week equals the same total volume over a week time period, but the associations with certain alcohol-related outcomes are different[27] [27]: the quantity of alcohol consumed on an occasion is a more powerful predictor of injury than frequency.[28] Globally, 35 percent of men and 55 percent of women (45

percent total) have never consumed alcohol (lifetime abstainers), and 13 percent of the population have not consumed alcohol in the past 12 months (former drinkers).[29] LMICs tend to have higher rates of abstention, especially of lifetime abstainers.[30] Globally, drinking patterns vary widely, and a number of ways to help describe cultural influences in research have been developed. "Wet" has been used to describe societies where alcohol has been highly integrated and is widely available. Wine is largely the beverage of choice in these regions (e.g., European countries around the Mediterranean). "Dry" cultures restrict alcohol more and abstinence is more common; drinking tends to be more intense when it occurs (e.g., Nordic countries, US).[31] In 2000, Rehm et al. developed a pattern of drinking score that included the usual quantity of alcohol consumed per occasion, festive drinking, proportion of drinking events when drinkers get drunk, proportion of drinkers who drink daily or nearly daily, drinking with meals, and drinking in public places.[32] This score, ranging from 1 (least risky drinking pattern) to 5 (most risky drinking pattern) contributes details to drinking at the population level that inform per capita volume measures.

Binge drinking (also referred to as heavy episodic drinking), usually defined as consuming five or more alcoholic beverages in a short time period for men and four or more for women, is a useful cut point identified in alcohol-related studies and is the amount of alcohol that leads to a blood alcohol concentration (BAC) of 0.08g/dL or above in an average adult.[33] A meta-analysis of fall injuries found a three-fold increase in risk of fall injury in people who had been drinking over sober controls; a BAC of 0.16g/dL increased the odds to 60.[34] Psychomotor effects, however, can be found at BACs as low as 0.02g/dL and increase in a dose-dependent manner.[35] There are issues with this cut point; it is not an actual measure of alcohol impairment, but is a proxy. It does not take body mass index into account, nor ingestion of food or other

drugs, which could lead to very different BACs.[36] In some studies, the cut point is 5 or more drinks for both men and women, even though women tend to reach a higher BAC even when controlling for body size.

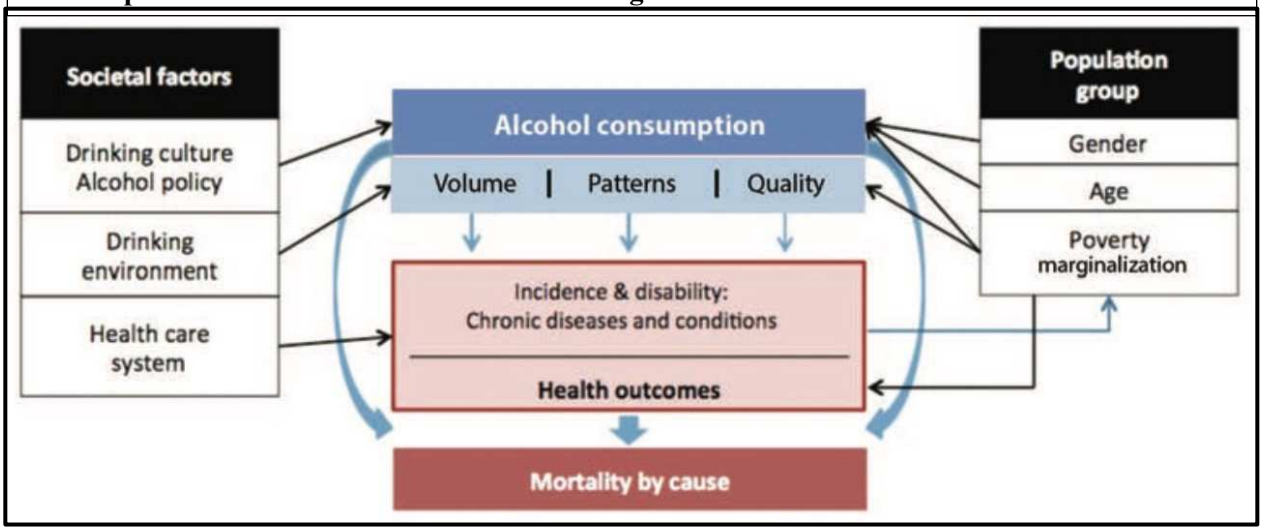
The last dimension, quality of alcohol, is included in the pathway between alcohol use and alcohol-related outcomes, but the public health implications are much less well understood.[37] It is often considered to be of much less importance than volume or pattern of drinking due to study locations in HICs. However, it is important to note that an estimated 30 percent of global alcohol consumption in 2000 was "unrecorded," with a majority of this volume coming from LMICs and the former Soviet Union.[37] This unrecorded consumption may be from smuggled alcohol or from home-distilled or brewed alcohol; the latter products are sometimes adulterated, and the adulterants (e.g. methanol) can cause serious health problems.

Alcohol and health effects

Alcohol is a causal or contributing factor in more than 200 diseases and injury conditions, including acute and chronic processes and infectious and non-communicable diseases.[3,4] Examples of alcohol use as a causal factor include alcoholic cirrhosis of the liver and alcohol poisoning (alcohol or alcoholic is included in the name) – alcohol must be present as a factor and is significant alone to cause the condition. Attributable fractions have been developed to calculate the proportion alcohol use contributes to other disease or injury processes such as cancer or homicide, where a combination of factors leads to the end state.[7]

Alcohol use is a leading risk factor for non-communicable diseases globally, including certain cancers, neuropsychiatric diseases, stroke and other cardiovascular diseases, and gastrointestinal diseases.[1] A combination of volume and pattern of consumption contribute to the causal impact of alcohol on chronic disease (Figure 1), an effect mediated by three main

Figure 1 Causal model of alcohol consumption, intermediate mechanisms, and long-term consequences, as well as the influence of societal and demographic factors on alcohol consumption and alcohol-related harms resulting in chronic diseases and conditions[1]



mechanisms: toxic effects of alcohol, consequences of intoxication, and consequences of dependence.[1,3] In 2008, the International Agency for Research on Cancer concluded that alcoholic beverages were carcinogenic to humans, specifically in the upper and lower digestive track and the female breast.[38] Many of the effects are dose-dependent. Light and moderate drinking has been found to be associated with colorectal cancer (CRC); however, a meta-analysis found heavy drinking (>=50g/day) was related to a 52 percent increase in the incidence of CRC and a 21 percent increase in CRC mortality.[39] A recent meta-analysis of upper aerodigestive tract (UADT) cancer found a significant increasing dose-response relationship between light (<=1 drink/day), moderate (2-3 drinks/day), and heavy (4+ drinks/day) consumption and risk for esophageal and other UADT cancers.[40] Neuropsychiatric conditions causally associated with alcohol use include alcohol use disorders (AUDs), epilepsy, and unipolar depressive disorder. A 2013 systematic review and meta-analysis of AUDs and mortality found a pooled relative risk (RR) of 2.98 for men and 4.64 for women, higher than previous estimates.[41] The cardiovascular system may experience both risks and benefits, although more recently, low dose alcohol

consumption's beneficial role in heart disease has been called into question after more rigorous epidemiological methods have been applied to existing data.[42]

Acute alcohol use leads to a greater number of deaths and years of potential life lost (YPLL) than chronic use. This is especially pronounced in youth, where death is predominantly from non-chronic causes and a greater number of years of life are lost due to their younger age. Both volume and pattern of consumption play a role in acute processes, as with chronic diseases; however, the cumulative effect is not generally a factor, with the focus being on the immediate context and intoxication. Alcohol poisoning is an example of an acute cause of morbidity and mortality where alcohol is a direct causal factor 100 percent of the time. AAFs exist for acute disease and injury states, including AAFs for harms with broader social implications such as homicide (AAF=0.47) and child maltreatment (AAF=0.16).[43]

A large burden of alcohol-attributable disease stems from injuries.[4] Injuries are categorized as unintentional and intentional, with the former category comprising the majority of the burden of morbidity and mortality. Injuries are the leading causes of death in youth ages 10-24 years; those related to alcohol use may result from intentional violent acts, such as fighting, or may be unintentional as from falls or motor vehicle crashes. Binge drinking, common among youth, is a pattern associated with greater risk of injury than for non-drinkers;[44] both frequency and intensity (number of drinks consumed during the binge) of binge drinking have been found to exhibit dose-response relationships with risk of injury.[45-47] Emergency department (ED) studies have found that injuries with higher severity and those which were intentional versus non-intentional are more likely to be alcohol-related.[48-50] In a retrospective review, Sindelar et al. found that almost 50 percent of ED trauma admissions among 13-19 year olds were alcohol-positive compared to only five percent of general admissions.[50]

A number of other acute processes are important contributors to the burden of alcohol-attributable disease in youth. There is a well-established causal association between alcohol use and violence.[51,52] Youth are more likely to be involved with violent behavior both as perpetrators and as victims, and, while less studied than adults, alcohol use is associated with both roles, despite it being an illegal product for many young people (depending on legal age of consumption).[53-56] Alcohol increases the risk of traffic crashes,[45] which are estimated to be the ninth leading cause of death in all age groups and the leading cause in 15 to 29 year olds. Low- and middle-income countries have twice the fatality rates of HICs, comprising 90 percent of total deaths.[57]

Development of a global strategy

By the early 1970's, alcohol was being recognized across the globe as a health-related problem demanding new attention. In 1975, the Finnish Foundation for Alcohol Studies published a report, *Alcohol Policies in Public Health Perspective*, that is widely regarded as the first in the post-World War II era to make the case that alcohol use and policies are significant public health concerns.[58] Shifting from the personal level to the macro-social, the "relevant public health objectives are to delineate for the drinking population as a whole, the risks of disease and premature death associated with different levels of alcohol consumption, and to seek means to minimize the number of drinkers in the hazardous range."[58(p67),59]

Also in 1975, Member States of the World Health Assembly (WHA) called upon the Director-General to "direct special attention…to the extent and seriousness of the individual, public health, and social problems associated with the current use of alcohol…and the trend towards higher consumption," a recommendation from a 1974 WHO Technical Report from the Expert Committee on Drug Dependence.[60,61(p48)] In 1979, the WHA passed a resolution

recognizing alcohol as a major contributor to global health problems, which was followed shortly thereafter by a review of existing preventive measures and programs and recommendations.[62] A project with three phases to understand, conduct research on, and make concrete recommendations to the WHO on alcohol production, marketing, and distribution was initiated in 1981. The Public Health Aspects of Alcohol Availability (PHAA) was unfortunately cancelled after phase 1, likely due to political intervention by the US and the UK under the Reagan and Thatcher administrations in the early 1980's.[63,64]

Almost two decades later, in 1999, the WHO released the first Global Status Report on Alcohol, marking the beginning of a new Global Alcohol Initiative, a "comprehensive effort to conduct and synthesize research, distil information based on the best available evidence, and provide technical assistance and policy guidance to Member States."[65(pix)] Since 1999, WHO has published five more global status reports on alcohol, which have included chapters or sections on consumption and health consequences and individual Member State profiles. In 2011 and 2014, alcohol policy information was included in the reports.[3,5] In 2001, WHO released the first (and only so far) Global Status Report: Alcohol and Youth.[66] In 2002, *Alcohol in Developing Societies* was published, a collaboration between the WHO and the Finnish Foundation representing a landmark effort to try to gather all the information about alcohol in LMICs in one place. In 2004, the WHO released the first Global Status Report on Alcohol Policies.[67] These reports were the result of increasing levels of global surveillance of alcohol use, problems and policies in WHO Member States, and provided the research basis for the first resolutions on alcohol to pass the WHA in more than two decades (WHA58.26 in 2005 and WHA61.4 in 2008).

These resolutions directly led to the development of the WHO's first Global Strategy to Reduce the Harmful Use of Alcohol in 2010 (the "Global Alcohol Strategy"),[12] which in turn

provided the platform for regional training sessions and strategies that raised the profile of alcohol policy among Member States. In the introduction to the Global Alcohol Strategy, then-Assistant Director-General for Non-communicable Diseases and Mental Health, Dr. Ala Alwan, framed the harmful use of alcohol as a development issue, reiterating that developing countries shoulder a greater burden of morbidity and mortality and echoing some of the impetus for a reduction in harmful alcohol use from the industrial revolution. The Global Alcohol Strategy aimed to reduce "health and social consequences of the harmful use of alcohol and make our communities healthier, safer, and more pleasant places to live, work, and spend our leisure time"[12(p8)] by providing general guidance, setting global priorities, and recommending policy interventions. The policy interventions are captured in 10 overarching target areas, each with a number of recommended options and interventions. The target areas include leadership, awareness, and commitment; health services' response; community action; drink-driving policies and countermeasures; availability of alcohol; marketing of alcoholic beverages; pricing policies; reducing the negative consequences of drinking and intoxication; reducing the public health impact of illicit and informally produced alcohol; and monitoring and surveillance. The Global Alcohol Strategy is careful to point out that the bulk of evidence is from HICs, however, and interventions must be culturally and contextually relevant for the greatest effect.

Alcohol control policies: overview

The history of restrictions on alcohol consumption is practically as long as the history of alcohol use itself. Rules for alcohol consumption are found to be integrated into the core myths and rituals of emergent cultures; much control was informal or cultural—drinking alone was predominantly seen as inappropriate; drunken behavior was generally proscribed; and women, non-free men, and other special groups were prohibited from imbibing.[68] Over time, laws

governing the use of alcohol in societies became more formalized, with the Code of Hammurabi from around 1720 BC being one of the earliest examples.[68] Inscriptions from 5 BC near the stadium at Delphi warn of a 5 drachma fine for bringing in wine.[69]

Alcohol consumption tends to rise with income and with national development.[15] As consumption rises, so does the need for social control over its potential harmful effects. Rules governing the use of alcohol in society, whether formal or informal, serve a number of purposes, including to protect the drinker and those around the drinker from the immediate or long-term harm that can be experienced from its use, situated broadly over three levels: "treatment" or "correction" of the "deviant drinker", cultural norms and education, and state-sponsored control systems.[70] Formal alcohol control policy has evolved over time, becoming primarily a means to regulate the supply of alcohol, for example through price or physical availability.[71] Mäkelä and colleagues define alcohol control as "…the intervention by the state in the production, trade, or purchase of alcoholic beverages…" [70(p67)] Far from being easily manipulated systems, alcohol controls are "elaborate networks of cultural, economic, and political structures…".[72(p2)]

As the industrial revolution occurred and incomes rose in many of the countries that are now HICs, alcohol consumption rose as well. Current alcohol control systems in HICs are deeply rooted in temperance movements that began to gain popularity in the post-industrialization time period,[70] as alcohol came to be seen as a detriment to progress. The alcohol policies that form the core of these control systems have been the targets of extensive research, and a significant body of knowledge exists to guide best practices.[73-75]

This large body of research suggests that stricter alcohol control policies lead to reductions in harm. In 1985, Mikhail Gorbachev introduced an Anti-Alcohol Campaign due to the massive detrimental health and economic effects alcohol was having on the Soviet

Republic.[76,77] This campaign included reducing state production of, increasing prices of, and reducing the number of outlets for spirits and wines; a prohibition on alcoholic beverage sales before 2PM; banning of liquor sales in restaurants; and removal of alcohol from public functions. Although these strict changes lasted only three years and, despite a massive increase in home or informal/illicit production, consumption declined from 11.2 liters per person in 1984 to 4.84 liters per person in 1988, and male life expectancy increased from 62.9 to 65.1 in three years.[76] Most are also familiar with the United States' "failed experiment" of prohibition in the 1920s and 30s; however, few are aware of the positive health effects that were seen. Acute alcohol overdose deaths and cirrhosis-related mortality rates dropped significantly, reaching the lowest levels seen before or since.[78]

Effective alcohol control is not based on a single policy, but a combination of policies and regulations coupled with appropriate levels of enforcement[75]; however, most research has evaluated individual policies. Babor et al.'s *Alcohol: No Ordinary Commodity* (published in 2003 and revised in 2010) was a game-changing compendium of evidence-based best practices in alcohol control, with rankings according to effectiveness.[75,79] This and other major public health resources, such as the Global Alcohol Strategy and the Centers for Disease Control and Prevention-supported Task Force on Community Preventive Services' guides,[80] have identified a range of interventions that are the most effective in addressing alcohol-related harm, including regulating physical availability, drink-driving prevention and countermeasures, advertising restrictions, and pricing and taxation. While these recommendations are geared toward population-level effects, part of an effective overall strategy must take special populations, such as youth, into consideration.

Alcohol policies

There are a number of policy domains that have been shown to be effective specifically for youth. These generally fall under the categories of availability, drink-driving prevention and countermeasures, advertising restrictions, and pricing and taxation.[74]

Availability in general refers to the ease with which alcohol is obtainable. Specifically, *physical availability* focuses on policies such as total or partial bans on sales, limited hours and days of retail sales, retail outlet licensing, outlet density, state monopolies, and minimum drinking age laws (lower drinking age increases availability to youth). Availability policies operate on the presumption that decreasing access to alcohol leads to a decrease in consumption leading to a decrease in alcohol-related harms. Minimum drinking age laws have been extensively studied in the U.S., and most results find that higher legal drinking ages lead to later initiation of drinking, reduced use by underage youth, and reduced frequency of heavy use.[81,82] O'Malley and Wagenaar found that the reduced use by underage youth had a persistent effect in young adulthood.[81] In a study using data from 1982 to 1997, Voas et al. found an 18.9 percent reduction in the odds that an under-21 driver in a fatal crash will have been drinking in U.S. states that had higher minimum drinking age laws.[83] Norberg et al. conducted a natural experiment comparing the 12 month prevalence of alcohol and substance use disorders in adults who experienced different legal drinking ages in the 1970s and 80s.[84] Exposure to a younger legal drinking age was associated with a more than 30 percent increase in the odds of reporting a past year alcohol use disorder, a finding that persisted to adults even in their 40s and 50s. Carpenter and Dobkin estimated the costs associated with reducing the drinking age to 18, as promoted by a group of college presidents known as the Amethyst Initiative.[85] They found that for every 100,000 young adults allowed to drink legally per year, mortality amounts to 8 additional lives lost with a cost of $70 million or over $15 a drink, which is a lower bound as

non-mortality outcomes were not included. They estimated the costs borne by people other than the drinker add an additional $2.63 per drink.

Drink-driving prevention and countermeasures may include policies such as minimum purchase age, higher prices on alcohol, efforts to reduce outlet density, and mass media campaigns.[74] There are also policies specifically targeting drivers, including lower legal blood alcohol content (BAC) or zero tolerance, random breath testing, and sobriety checkpoints, that have been found to be effective in reducing morbidity and mortality from motor vehicle crashes.[86] Wagenaar et al. found a 19 percent reduction in driving after drinking and a 23 percent reduction in driving after binge drinking for youths under 21 in states that lowered the youth-specific BAC limit to 0.00-0.05 compared to 0.08 or 0.1.[87] Japan reduced its legally-permissible BAC from 0.05 to 0.03 in 2002 and saw a 64 percent reduction in alcohol-related crashes involving teens in the three years following enactment.[88] Studies from the U.S., Canada, France, and Australia that were included in a systematic review of sobriety checkpoints found strong and consistent evidence of their effectiveness in reducing fatal and non-fatal crashes and crashes involving property damage.[89]

Recent research consistently supports the association between youth exposure to alcohol advertising and alcohol use. Advertising may include ads on television or in magazines,[90] ownership of branded materials[91,92] and point of sale ads.[93] A 2009 systematic review of longitudinal studies found that exposure to alcohol advertising (including ownership of branded materials, volume and type of exposure) was associated with an increased likelihood of starting to drink for baseline non-drinkers or to drink more for baseline drinkers.[94] The alcoholic beverage industry strongly supports self-regulation of advertising, but a 2016 systematic review looking at both content of advertising and exposure found that all 19 studies that focused on a

specific marketing code and 25 content analysis studies "detected content that could be considered potentially harmful to youth."[95(p16)]

Effects of taxes on use of alcohol and negative consequences have also been extensively studied over the last few decades. A topic of interest to social scientists and economists alike, taxes and other price interventions not only have population-level effects on volume and patterns of alcohol use, but also generate revenues for governments. A 2009 meta-analysis of 112 studies found a 10 percent increase in the price of alcoholic beverages was associated with a 5 percent to 8 percent decrease in drinking.[96] This association is seen with light, moderate, heavy, and underage drinkers.[75,96] A 2010 systematic review including studies of both adults and youths estimated that doubling the alcohol tax in the U.S. would lead to a 35 percent reduction in alcohol-related mortality, an 11 percent reduction in traffic crash deaths, a 6 percent reduction in sexually transmitted infections, a 2 percent reduction in violence, and a 1.4 percent reduction in crime.[97]

Alcohol policies and youth in LMIC settings

While the majority of the literature evaluating alcohol control policies and youth-related outcomes has been in HICs (and is the focus of the literature review thus far), there are important results from LMICs, especially from more recent years.

Availability

Alcohol availability in LMICs has not been extensively studied, particularly for youth. Recent studies have evaluated alcohol industry involvement in developing countries and have found an increase in availability stemming from corporate social responsibility activities.[98,99]

Advertising

Swahn et al. have evaluated exposure to alcohol advertising and the relationship to alcohol use in youth in the Philippines, Uganda, and Zambia. Results in the Philippines and Zambia were based on the WHO's Global School-based Student Health Survey (GSHS) of 13-15 year old students; in Zambia, having received free alcohol from a company representative (one of their measures of alcohol marketing exposure) was significantly associated with drunkenness and with "problem drinking" (i.e., reports of a hang-over, feeling sick, missing school), even after controlling for exposure to alcohol education.[100] In the Philippines, being offered free drinks from an alcohol company representative or receiving an alcohol-branded item were significantly associated with drunkenness, as was seeing alcohol ads in newspapers and magazines or seeing ads at sports events, concerts or fairs even after controlling for a number of covariates.[101]

Drink-driving

A survey of over 18,000 university students from 22 LMICs and emerging economies (defined as high income, non-Organization for Economic Coorporation [OECD] members) across Africa, Asia, and the Americas found that 17.3 percent reported driving a car or motorcycle after drinking too much in the last 12 months.[102] There was great variation, however, with Bangladesh, Indonesia, and Kyrgyzstan reporting less than 5 percent prevalence and China, Singapore, and Thailand reporting over 35 percent. Higher prevalence rates were significantly associated with upper-middle and high-income countries. In an earlier survey of university students in 23 countries, of the LMIC countries, Colombia and Venezuela were found to have some of the highest prevalences of driving after drinking, while Thailand was among the lowest.[103] Evaluations of drink-driving interventions are scant in LMICs and not youth-specific. One time-series analysis in Brazil found that a 2008 national policy lowering legal BAC for

driving from 0.06 to 0.02 g/dL reduced traffic fatalities in the capital of Sao Paolo by 16 percent and traffic injuries by 2.3 percent.[104]

Pricing

In Thailand, a middle-income country, a 10 percent increase in alcohol excise tax rates was associated with a 4.3 percent reduction in the prevalence of lifetime drinking in a sample of over 87,000 15-24 year olds between 2001 and 2011.[105] Despite this overall reduction, the authors also noted an increase in drinking initiation in the most recent birth cohorts, an important finding since Thailand has seen an increase in per capita consumption from 0.26L in 1961 to 6.16L in 2010.

Influential factors

There are a number of protective and influential factors related to youth alcohol use. Adolescent alcohol use varies in drinking patterns and volume across cultures and within countries. It has been found to be associated with adult levels of consumption, likely due to a number of reasons including how adults model drinking behavior and because underage youth commonly report obtaining alcohol from adults (whether a parent or other adult of legal age).[106-110] Other country-level aspects of alcohol use that may also be important include the percentage of abstainers in the population and the proportion of binge drinkers.[111] Abstention rates have been shown to explain a large proportion of the variation in alcohol consumption in rich versus poor regions.[112] Religion has been shown to be a protective factor against alcohol use. In the Dominican Republic, a highly Catholic country, more frequent church attendance by students was related to delayed initiation of drinking and decreased prevalence of current drinking and binge drinking.[113] Sinha et al found that church attendance in the last month was significantly

associated with lower prevalence of current alcohol use in a nationally representative sample of 11-18 year olds in the United States.[114]

Global alcohol policy analyses

Over the last 30 years, significant strides have been made in developing alcohol policy scales to collectively track country-level alcohol indicators and perform cross-country comparisons. These scales create a measure of stringency of the alcohol policy environment over a number of domains so countries may track how the policy environment strengthens or weakens over time and to facilitate comparisons across countries. These tools can be extremely useful for surveillance and targeting weaker areas of alcohol control, but their development has been based almost exclusively on research in HICs. One large project, the Alcohol Measures for Public Health Research Alliance (AMPHORA), was a collaboration of 33 partner institutions from affiliated organizations from all 27 European Union (EU) member states to "provide new scientific evidence on the most effective public health measures to reduce the harm done by alcohol" and to "promote the translation of science into policy and disseminate new knowledge to policymakers."[115,116] Dozens of scientific articles came out of this project, contributing significantly to the understanding of alcohol use, factors associated with use, and policies in the EU. Funded projects looked at numerous topics, including the role of illicit alcohol in health risks, risks to youth from exposure to alcohol marketing, and influential environmental factors in alcohol use. One major project was to create a policy comprehensiveness and restrictiveness scale and apply it in 33 countries; findings included that a stricter policy score was associated with lower alcohol consumption levels.[117] Other findings supported restricting the physical and economic availability of alcohol as one of the most effective tools affecting consumption and related harms.[115] Alcohol excise taxes were also found to be very effective, and a dose-response

effect was found linking high levels of exposure of young people to online alcohol marketing and binge drinking.[115] While AMPHORA included affiliates from across the EU, the core participating countries were Germany, Italy, Spain, Switzerland, Austria, and England, and most of the research and findings were confined to these and other HICs in the EU. For the alcohol policy scale project, however, researchers included some upper middle-income countries and categorized them in two ways: first by ranking them by policy score strictness and second by dividing them into four regions based on drinking patterns, consumption levels, and historical background.[117] The upper-middle income countries ranged widely in policy score restrictiveness, but were confined entirely within one of the four regions, demonstrating an alternative approach to categorizing countries for investigation and interpretation of findings. This may suggest that there are characteristics of alcohol use that countries of lower income levels may share that are different than HICs and should be taken into consideration in research projects. By simply categorizing countries based on income, more nuanced findings may be masked.

In 2007, Brand et al. published findings based on their development of an Alcohol Policy Index (API) that was applied in the 30 countries of the OECD.[118] A strong negative correlation was found between the API score and per capita alcohol consumption; for each 10 point increase in the score, a one liter decrease in absolute alcohol consumption was noted. Three countries were found to be the only outliers to this relationship, and the authors offered explanations related to high unrecorded alcohol consumption (Mexico), poor enforcement (Hungary), and religious influence (Turkey). While these explanations are valid, no mention was made that these were the only three countries that were not HICs.

Analyses of alcohol policies have also been undertaken in the U.S. Naimi et al. created an alcohol policy scale (APS) based on Brand et al.'s API[118] that included 29 policies to assess the

alcohol policy environment in all 50 states and evaluate the relationship with binge drinking in adults ages 18 and older. Higher APS scores were found to be inversely correlated with binge drinking prevalence and accounted for much of the variation in state-level binge rates.[119] More recently, Xuan et al. used the APS in the first study to assess the alcohol policy environment and alcohol consumption among US high school students; they found a 10 point increase in the APS was associated with an 8 percent reduction in the odds of youth drinking and 7 percent reduction in the odds of youth binge drinking across all states.[120]

In the international context, alcohol policy scales have found consistent results in the last decade in HICs and include youth-focused evaluations. In 2009, Paschall et al. evaluated the API in the same 30 OECD countries that were included in Brand et al.'s study, but used five measures of youth consumption as the outcome variables. They found alcohol availability and advertising restrictiveness scores to be inversely correlated with current alcohol use in 15-16 year olds in these countries.[108] In 2012, Gilligan et al. included drunkenness in addition to weekly drinking as outcomes for 15-16 year olds in 40 countries, but included the Rehm pattern of drinking (POD) score (as a surrogate for adult drinking) and relative prices in addition to the API.[107] Greater relative price, greater policy score, and POD score were negatively associated with weekly drinking, but not with drunkenness. The authors suggest that positive correlation between the POD and youth drunkenness may indicate that youth adopt adult drinking patterns. Bendtsen et al. used multilevel modeling specifically to evaluate adult consumption and the relationship to youth (13-15 year olds) consumption in addition to national policies in 37 HICs; they found a consistent relationship between high adult consumption and youth drunkenness after controlling for other factors in adult drinking and alcohol policies.[111] However, they also

found negative associations between strictness of alcohol control policies and weekly drinking among youth even after adjusting for adult consumption.

A number of LMICs have been included in cross-national policy score analyses. Carragher et al. modified Brand et al.'s API by including comprehensive levels of stringency and enforcement. They found an inverse relationship with their Toolkit for Evaluating Alcohol policy Stringency and Enforcement (TEASE-16) score and income-adjusted alcohol consumption per capita in six HICs (Australia, China, Hong Kong Special Administrative Region, Japan, New Zealand, Singapore) and three LMICs (Malaysia, the Philippines, Vietnam) in the western Pacific region: a 1 point increase in the scale led to a 1.8 percent reduction in per capita consumption.[121] Cook et al. were the first to evaluate alcohol policies and adult consumption (18-65 years) in a selection of purely LMICs (15 countries).[122] Evaluating the policies individually due to the small number of countries, they found physical availability, high prices, and advertising restrictions to be associated with lower consumption, but found no association with motor vehicle policies, which they attributed to questionable levels of enforcement in LMICs and unmeasured cultural and social confounders. Most recently, Ferreira-Borges et al. updated the API (it was based on 2003 data) and adapted it for use in 46 low- and middle-income African countries.[123] Using consumption among drinkers due to the high rates of abstention in Africa, they found that as a country's restrictiveness score increased, per capita consumption among drinkers decreased.

Limitations, however, include the difficulty in accounting for unrecorded alcohol (up to 30 percent of consumption may be unrecorded in African countries) and lack of implementation of policies in many countries, making the effects difficult to accurately analyze.[123] Another gap in the process is that even minimal primary evaluation of the policies being used to construct

these scales has not been done in low-income settings. There is an assumption that the same best practice policies for HICs will work in LMICs, which is not comprehensively documented in the literature. These scales also do not look at outcomes in special populations specifically, including youth.

Most importantly for this dissertation, at this time, no cross-national studies of alcohol policies or policy scores have been conducted in a youth population in LMICs. There has been substantial work done on alcohol policy scoring, and there also exists data that have not been analyzed regarding youth alcohol consumption and related harms in LMICs, in the form of the Global School-based Health Survey (GSHS). This dissertation will begin by analyzing the demographics of prevalence of drinking in LMICs according to data from this survey, and then examine the risks of alcohol-related harms. Finally, building on the work already done on alcohol policy scoring and risks of alcohol-related harms among adults, this dissertation will use the data on prevalence to test whether more restrictive alcohol policy environments also have the potential to reduce youth drinking.

PAPER 1

Prevalence of Alcohol Consumption Among Youth in Low- and Middle-Income Countries

ABSTRACT

Introduction

Alcohol is a leading risk factor globally for death and disability, but little is known about patterns of consumption in youth in low- and middle-income countries (LMICs). The objective of this study was to determine the prevalence of alcohol consumption among youth in LMICs and identify patterns according to individual and country-level factors.

Methods

Data from 24 LMICs and one autonomous region were collected as part of the World Health Organization's Global School-based Student Health Survey (GSHS) between 2010-2015. National samples of 1,119 (Vanuatu) to 28,368 (Argentina) 12-16 year olds were collected through self-administered questionnaire in a classroom setting. Prevalence of alcohol consumption was evaluated on three levels: non-drinker, current drinker without binge drinking, and binge drinker. Correlational analyses were conducted between youth consumption and adult per capita consumption.

Results

Prevalence of current alcohol use ranged from 7.3% in Syria to 55.9% in Jamaica; prevalence of binge alcohol use (of current drinkers) ranged from 3.8% in Ghana and Syria to 35.1% in Argentina. Males reported greater current alcohol use than females in all except two countries, while within current drinkers, females reported greater binge drinking in 13 of 25 locations. Lower prevalence of consumption was found in low-income countries and countries with Islam and Hindu as the national religion. Youth current and binge alcohol consumption were strongly correlated with adult consumption.

Discussion

One in five students in LMICs reported consuming at least one alcoholic beverage in the past 30 days. Females have traditionally been protected by high rates of abstention, but concern has been growing in high-income countries that female alcohol consumption is converging with male consumption, a pattern identified here. Youth drinking may be influenced by adult consumption patterns, underscoring the need for additional research to related to relationships of alcohol consumption and harm and effective population-level policy interventions in LMICs.

INTRODUCTION

Alcohol use is among the seven leading risk factors for global disease burden, behind high blood pressure, tobacco smoking, and high body-mass index, and the leading risk factor for death in 10-24 year olds.[2] It accounts for 3.3 million deaths and 5.1% of global disability-adjusted life-years (DALYs)[3] and is a causal or contributing factor in more than 200 disease and injury conditions such as cirrhosis of the liver, poisonings, road traffic crashes,[4] tuberculosis, and certain cancers.[3,6]

Excessive alcohol use has been called a development issue due to its potential negative social impact beyond just the health impact in emerging countries.[12] Industrialization brings more expendable cash for luxuries such as imported processed foods and alcoholic beverages in addition to more time to enjoy such luxuries with a move away from laborious agrarian lifestyles. Alcoholic beverages can be symbols of "cosmopolitanism, and on the other hand, with national pride."[13, p3-4] Papua New Guinea is one of the least developed countries on the planet, but they have a locally-brewed beer that is warmly referred to as "Our Beer" right on the label, despite its being a subsidiary of the Dutch company, Heineken. A healthy workforce is necessary as societies expand, and alcohol-related harms (such as intentional and unintentional injuries, workplace absenteeism, and motor vehicle crashes) increase as development increases.[14,15] Additionally, lower-resourced countries have health systems that are more likely to be inadequate to appropriately treat acute injuries or provide mental health and addiction services that may be more readily available and reliable in high-income countries (HICs), leading to a greater burden of harm even from lower overall consumption.[3]

Youth are a particularly vulnerable group to the effects of alcohol because of their smaller stature, lack of tolerance, and inexperience with drinking, but are frequently not included

in studies analyzing consumption patterns, volume, types of beverages consumed, and other epidemiological factors necessary for effective programmatic and policy interventions. Males experience a greater burden of alcohol-related morbidity and mortality, due in part to higher rates of abstention and less harmful drinking patterns in females.[9,10] Globally, 10-24 year-olds have a higher burden of alcohol-caused DALYs (7%) than other age groups, again with males shouldering the greater burden – as of 2010, alcohol was the leading cause of death and disability for males ages 15-24 in every World Health Organization (WHO) region except the Eastern Mediterranean (EMR). It was also the leading cause of death and disability for females in this age group in HICs and the Region of the Americas (AMR).[11]

Young people drink less frequently than adults, but tend to have more harmful patterns of consumption. Binge drinking, defined here as five or more alcoholic beverages for males and four or more alcoholic beverages for females on one occasion, is the pattern by which the majority of alcohol is consumed by youth[124,125] and is associated with even greater harms than alcohol consumption that is not considered binge drinking, including physical and sexual assault and driving after drinking.[44,126] Additionally, earlier age of initiation of drinking has been found to be associated with increased risk of alcohol-related problems through the life course, including dependence and abuse.[127,128]

Youth alcohol use has been shown to be influenced by adult drinking, likely due to a number of reasons including how adults model drinking behavior and because underage youth commonly report obtaining alcohol from adults (whether a parent or other adult of legal age).[107,110,129,130] Xuan et al. found that a 5% increase in binge drinking prevalence in US adults was associated with a 10% increase in the odds of youth drinking and binge drinking.[131] Fuhr and Gmel demonstrated a strong correlation between adult recorded per capita consumption and

youth drinking prevalence in 68 countries across all WHO regions (Pearson's correlation coefficient of r=0.81).[106]

While these drinking patterns have been extensively studied in high-income areas such as the US and Europe, there is a paucity of data on youth drinking in low- and middle-income countries (LMICs). Research suggests that youth consume even less than adults in LMICs compared to youth in HICs; however, the prevalence of binge drinking is unknown. This study makes novel use of existing data to quantify youth drinking prevalence on three levels (non-drinkers, current drinkers without binge drinking, current drinkers with binge drinking) and identifies patterns according to a number of individual and country-level predictors including sex, country-level income, and major religion in 24 low- and middle-income WHO Member States and one autonomous region. We will also explore the relationship between population level adult per capita consumption (including unrecorded consumption) and individual-level youth consumption within and across countries. We hypothesize that lower rates of alcohol consumption will be associated with female sex and with countries that are lower-income or majority Muslim.

METHODS

Data Sources

Global School-based Health Survey (GSHS)

The GSHS was developed by the WHO in collaboration with United Nations' Children's Fund (UNICEF), UN Education, Scientific and Cultural Organization (UNESCO), and UN Joint Programme on HIV/AIDS (UNAIDS), and with technical assistance from the U.S. Centers for Disease Control and Prevention (CDC). It was designed to measure and assess the behavioral risks and protective factors in 10 key areas among 13-17 year-old students, primarily in LMIC

(as defined by World Bank cut points) settings. The survey uses a standardized sample selection process to collect age, sex, and country-specific grade levels, and includes 10 country-based core modules on the following topics that cover the leading causes of morbidity and mortality worldwide: alcohol use, dietary behaviors, drug use, hygiene, mental health, physical activity, protective factors, sexual behaviors, tobacco use, and violence/unintentional injury. It is implemented at a country level, uses a standardized cluster sample selection process to collect age, sex, and country-specific grade levels, and is designed to be self-administered by students with pen and paper in one class period. The first stage of the two-stage sampling design uses a probability proportionate to size method to select schools from a list of all schools. The second stage targets classrooms within the schools with students of the target age groups; all students within the chosen class are eligible to participate. Completed data sheets are sent to CDC for processing and editing of data (checking responses for logical consistency, etc); the same edits are used in all countries to ensure comparability across countries. Final data files contain weighted data, allowing results to be generalized to the entire population of students in each country.

GSHS datasets are available as far back as 2003,[132] but older data may not be as informative due to changes over time in national income or population demographics. Data only become publicly available online two years after the final report is approved by the country. While an estimated 64 countries completed the GSHS between 2010-2015 and publicly posted their data, not all completed the alcohol module. The Cook Islands, Niue, Nauru, and Tuvalu each only had one stratum with one primary sampling unit (PSU) for the entire survey, which does not allow for parameter estimation using survey methods; these countries were not included. Rodrigues is an autonomous region within Mauritius; it fielded its own survey, results

from which were included. Eight countries (six in AMR, one in the Africa Region [AFR], and one in the Western Pacific Region [WPR]) were identified under the World Bank classification as high-income and were excluded. For these reasons, 25 datasets from 2010-2015 for 24 countries and one autonomous region were included in the analyses for this study (Table 1.1).

Global Information System on Alcohol and Health (GISAH)

The GISAH has been a part of the WHO's Global Health Observatory data repository since 1997 and is a collection of data obtained from countries on a wide range of alcohol-related health indicators under eight categories: levels of consumption; patterns of consumption; harms and consequences; economic aspects; alcohol control policies; prevention, research and treatment; youth and alcohol; and key alcohol indicators relevant to non-communicable diseases. The GISAH is informed by numerous data sources such as country-level surveys and government documents. Adult (age 15+, total unrecorded and recorded, 2008-2010 average) per capita alcohol consumption was obtained through GISAH.

Measures

Two questions from the GSHS were used to assess current and binge drinking among respondents. To assess consumption frequency, students were asked, "During the past 30 days, on how many days did you have at least one drink containing alcohol?" Students reporting drinking one or more drinks in the past 30 days were categorized as "current drinkers." To assess quantity, students were asked, "During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink per day?" Males students reporting five or more and female students reporting four or more drinks were categorized as "binge drinkers."

One question from the GSHS was used to calculate age of initiation. Students were asked, "How old were you when you had your first drink of alcohol other than a few sips?"

Analysis

Sample sizes varied from 1,119 (Vanuatu) to 28,368 (Argentina), with a median of 2,286 (Table 1.1). Analyses were based on survey respondents who had answered both the alcohol quantity and the alcohol frequency questions in the GSHS.

For each country, population-level (i.e. all-youth) prevalence of current drinking, prevalence of current binge drinking among students who reported current drinking, and average age of initiation were calculated from the GSHS. Prevalence of current drinking and binge drinking and age of initiation were then calculated for each country by age, sex, predominant religion, and national income level (using World Bank classification levels[133]). Correlations of youth drinking prevalence and adult per capita consumption were evaluated in Stata 14.2 using Pearson's correlation coefficient to calculate the direction and strength of relationships. Analyses, including prevalence estimates and 95% confidence intervals (CIs) were also calculated using survey methods in Stata to appropriately account for the 2-stage design and weighted results.

RESULTS

Current drinking and binge drinking prevalence

Current alcohol use ranged from a low of 10.1% in Cambodia (CI: 8.3-12.3) to a high of 55.9% in Jamaica (CI: 53.6-58.1) (Table 1.2). Highest rates for each WHO region were for Namibia in AFR (33.9%, CI: 31.3-36.6), Jamaica in AMR (55.9%, CI: 53.6-58.1), Lebanon in EMR (27.3%, CI: 19.1-37.4), and Samoa in WPR (36.7, CI: 30.5-43.4). Overall, males reported more current drinking than females except in Rodrigues (25.8%, CI: 22.0-30.1 vs 27.3%, CI: 23.7-31.2), Honduras (14.3%, CI: 11.4-17.8 vs 17.1%, CI: 13.8-20.9), and Tonga (17.6%, 14.7-21.0 vs 19.1%, CI: 16.1-22.5), although none of the differences were significant.

The prevalence of binge drinking was calculated among students reporting current drinking and ranged from 3.3% in Ghana (CI: 1.5-6.9) to 35.1% in Argentina (CI: 33.3-37.0). Females reported binge drinking more than males in 17 of the 25 countries and regions and ranged from a low of 4.6% (CI: 1.9-10.6) in Ghana (males: 2.2%, CI: 0.7-6.8) to a high of 36.3% (CI: 33.3-39.4) in Argentina (males: 33.8%, CI: 31.0-36.7), although El Salvador was the only country where the difference was statistically significant (males: 15.2%, CI: 9.8-22.7; females: 32.2%, CI: 25.4-39.8). The mean for binge drinking prevalence among current drinkers was higher for females than males in AMR (19.2% vs 15.8%) and WPR (13.9% vs 12.5%) regions (Figure 2).

Current drinking prevalence was greatest for countries identified as Roman Catholic (27.3%) or Protestant (27.5%) as the major religion and lowest for Buddhist (9.5%) and Muslim (14.5%) countries. Binge drinking demonstrated a similar pattern, except that binge drinking in predominantly Roman Catholic countries was more than twice as prevalent as in mostly Protestant countries (6.4% vs 3.2%). The greatest current drinking prevalence was reported in the AMR region for both males (34.7%) and females (30.2%). Lowest current drinking for males was for the WPR region (24.3%) while EMR had the lowest prevalence for females (11.8%). Across all religions, WHO regions and World Bank income levels, males consistently reported current drinking at greater rates than females. Current and binge drinking prevalence were greatest in the upper-middle income countries (current: 34.5%, binge: 5.9%) and lowest in the low-income category (current: 18.4%, binge: 2.5%) (data not shown).

Youth consumption, adult per capita consumption

Most countries with higher rates of adult per capita consumption demonstrated higher prevalence of youth current drinking, and to a lesser degree, youth binge drinking prevalence

(Figure 3). Youth current drinking prevalence had a Pearson's correlation coefficient of r=0.50 ($p<0.05$) with adult per capita consumption. Youth binge drinking prevalence and adult per capita consumption were similarly correlated (r=0.44, $p<0.005$).

Age of initiation

Age of initiation ranged from 9.8 years in Samoa to 15.3 years of age in Cambodia. Males were earlier initiators in all countries except Namibia (12.7 vs 12.6), Cambodia (15.4 vs 14.9), and the Solomon Islands (12.4 vs 11.7) (Table 1.3).

DISCUSSION

This study demonstrates that about 1 in 5 students ages 13-16 years in low- and low-middle income countries reported consuming at least one drink in the past 30 days. Consumption was lower in Buddhist and Islamic countries compared to Roman Catholic and Protestant. The AMR region had the highest average drinking rates, including the top three highest rated countries overall. This could partly be explained by the fact that the AMR region contained no survey countries in the low-income category; however, this does not entirely explain the situation in AMR. For instance, Guyana is low-middle income and students reported a higher prevalence of consumption than any country in AFR, EMR or WPR (41.4%). The pattern of alcohol consumption increasing as national incomes increased was replicated in this sample of countries, with young people in low-income countries drinking less than students in either low-middle- or upper-middle-income countries.

While young men generally reported higher prevalence of drinking, young women reported a slightly higher prevalence of binge drinking in the majority of countries, suggesting that if young women drink, they are more likely to drink with greater intensity than young males. This is of concern because the same volume of alcohol can cause greater harm in a woman's

body than in a man's.[134] Regarding acute consequences, women reach higher BACs with the same amount of alcohol consumption as men due primarily to lower body water composition and smaller stature, and may be at higher risk for unintentional or intentional injuries and other negative health outcomes. In terms of chronic disease outcomes, women experience greater risks than men for a number of alcohol-related diseases including liver cirrhosis, breast cancer, cardiovascular disease, and certain neurological effects.[135]

The significant correlation between young people's drinking and adult per capita consumption by country confirms work that has been done in high-income countries and expands upon what has been done in LMICs.[120,130] Fuhr and Gmel's study across 68 LMICs found a stronger correlation between youth current drinking and adult per capita consumption (r=0.81 vs r=0.50), but they did not take unrecorded alcohol into account. Unrecorded alcohol may represent a larger percentage of total alcohol in less resourced countries,[3] which could change the strength of the correlation. The correlation in this study is still strong and suggests that population-level alcohol policies that influence adult drinking, such as taxation or restrictions on physical availability, may also affect youth drinking. Age of initiation is lower than 13.1 years in all but one country; in the US, age of initiation was 14.6 years in 2013-2015,[136] suggesting that there may be greater access to alcohol at a younger age in the study countries. While research on population-level alcohol policies has been done in HIC settings,[137] future research should explore whether these policies are also effective in LMIC settings as well.

There are a number of limitations in this study. Because the data are cross-sectional, causation cannot be determined. Alcohol use may be significantly underreported, with self-reported surveys capturing between 22-32% and 40-60% when compared to sales data.[19,20] Social desirability may also play a role in over- or under-reporting alcohol use; students in

Muslim-majority countries may be less inclined to report any alcohol use, as it is less culturally accepted. Misclassification of drinking patterns may stem from the design of the binge drinking variable. The GSHS question on volume asks for the *usual* number of drinks consumed when the student drinks and does not separately ask about binge drinking occasions. For example, a student who drank two drinks each week in the past month but binge drank on a weekend would likely report only two drinks as that is the usual amount, leading to misclassification as a current drinker without binge drinking. The average age of initiation only applies to students who have already started drinking, so estimates tend to be lower. The GSHS only captures students in school who were present on the day the survey was administered and may not be representative of the population as a whole. Young people who have dropped out of school, are incarcerated or absent on that particular day may be different from the survey respondents. The GSHS also only represents a limited range of countries in the chosen time frame and an even more limited number who completed the alcohol module. Further, as the EMR region only contained two survey countries and the AFR region three, it is unlikely that these results can be used to draw conclusions about these regions.

Despite these limitations, this study confirms a number of hypotheses based on research from HICs: lower prevalence of alcohol consumption is associated with female sex, countries with Islam or Hindu as the majority religion, and lower country-level income levels. It also underscores global calls for greater action on alcohol in low-income countries, since it appears that as national incomes increase, consumption among youth is likely to increase. Recent findings in the US have found that although young people are drinking less overall, some report binge drinking at much greater intensities (greater number of drinks in one sitting), potentially leading to the increases that have been seen in some harmful underage alcohol use

consequences.[138,139] This phenomenon was evident in females in this survey, particularly in the AMR region (six of eight countries), which is in line with the finding that alcohol is the leading cause of death and disability in females ages 15-24 in the Americas.[11] That females also reported greater prevalence of binge drinking in five of the 11 countries in the predominantly lower-income WPR region may be cause for concern as well. Further research should identify more specific risk and protective factors for higher intensity drinking among females in low-income settings. Consideration should also be given to expanding the core alcohol-related question of the GSHS to capture binge drinking more accurately, including binge frequency and intensity. In 2013, the CDC's Youth Risk Behavior Surveillance Survey began asking for the largest number of drinks consumed on one occasion in the past month, providing information on the intensity of binge drinking.[140] This study was only able to use country-level predictors; additional studies should capture, at a minimum, religion and income at the individual-level. Additionally, as this study only includes 24 countries that completed the alcohol module, with only three from AFR, two from EMR, and none from SEAR, a greater breadth of data collection is necessary to identify patterns that may hold across these other areas of the world. Finally, further research should attempt to link these prevalence data with specific disease and injury outcomes as they are available. It should also explore the degree to which different alcohol policy environments at the national level may influence youth drinking and associated negative consequences.

Table 1.1. Descriptive data on study countries

Country by WHO region	Date of survey	Country Population	Survey Respondent	World Bank Classification[a]	Major Religion
AFR		*989,173,178*			
Ghana	2012	27,409,893	1,471	LM	Christian
Mauritius	2011	1,273,212	2,168	L	Hindu
Rodrigues[b]	2011	-	1,136	L	Roman Catholic
Namibia	2013	2,458,830	4,531	UM	Christian
AMR		*986,705,352*			
Argentina	2012	43,416,755	28,368	UM	Roman Catholic
Belize	2011	359,287	2,112	LM	Roman Catholic
Bolivia	2012	10,724,705	3,696	LM	Roman Catholic
El Salvador	2013	6,126,583	1,915	LM	Roman Catholic
Guyana	2010	767,085	2,392	LM	Protestant
Honduras	2012	8,075,060	1,779	LM	Roman Catholic
Jamaica	2010	2,793,335	1,623	UM	Protestant
Peru	2010	31,376,670	2,882	UM	Roman Catholic
EMR		*643,784,038*			
Lebanon	2011	5,850,743	2,286	UM	Muslim
Syria	2010	18,502,413	3,102	LM	Muslim
WPR		*1,855,125,789*			
Cambodia	2013	15,577,899	3,806	L	Buddhist
Fiji	2010	892,145	1,673	LM	Protestant
Kiribati	2011	112,423	1,582	LM	Roman Catholic
Malaysia	2012	30,331,007	25,507	UM	Muslim
Mongolia	2013	2,959,134	5,393	LM	Buddhist
Philippines	2011	100,699,395	5,290	LM	Roman Catholic
Samoa	2011	193,228	2,418	LM	Protestant
Solomon Islands	2011	583,591	1,421	LM	Protestant
Tonga	2010	106,170	2,211	LM	Protestant
Vanuatu	2011	264,652	1,119	LM	Protestant
Vietnam	2013	93,447,601	3,331	LM	None

[a] L=low; LM=low-middle; UM=upper-middle; H=high

[b] Autonomous region of Mauritius

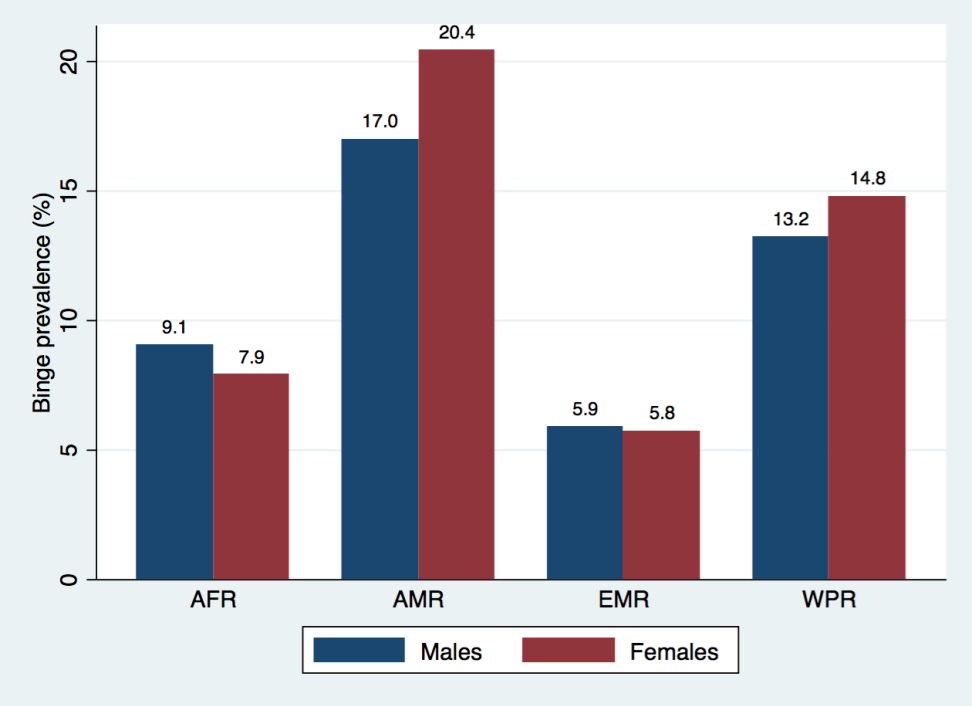
AFR = African region of the WHO, AMR = Region of the Americas, EMR = Eastern Mediterranean region, WPR = Western Pacific region

Table 1.2. Prevalence of current alcohol use and current binge alcohol use by current drinkers, total and by sex

Country by WHO region	Date of survey	Current alcohol use[a]			Current binge use (drinkers only)[b]		
		Total % (95%CI)	Males % (95%CI)	Females % (95%CI)	Total % (95%CI)	Males % (95%CI)	Females % (95%CI)
AFR							
Ghana	2012	16.1 (13.1-19.7)	17.5 (14.5-20.9)	14.7 (10.7-19.8)	3.8 (1.5-8.9)	2.3 (0.5-10.1)	5.6 (2.2-13.7)
Mauritius	2011	24.2 (20.9-27.7)	26.4 (20.2-33.7)	21.7 (15.8-29.1)	10.1 (7.9-12.9)	11.3 (8.5-15.0)	8.7 (6.4-11.8)
Rodrigues[c]	2011	26.7 (23.7-29.8)	25.8 (22.0-30.1)	27.3 (23.7-31.2)	8.3 (4.5-14.9)	9.4 (4.4-18.9)	7.4 (3.9-13.7)
Namibia	2013	33.9 (31.3-36.6)	39.2 (35.4-43.1)	29.2 (26.9-31.5)	12.2 (8.8-16.6)	13.3 (9.4-18.4)	10.9 (6.9-16.9)
AMR							
Argentina	2012	51.7 (49.1-54.3)	52.0 (49.2-54.8)	51.5 (48.4-54.6)	35.1 (33.3-37.0)	33.8(31.0-36.7)	36.3 (33.3-39.4)
Belize	2011	28.8 (25.5-32.3)	31.3 (27.5-35.2)	26.6 (22.0-31.7)	18.3 (13.9-23.7)	17.8 (12.2-25.3)	18.8 (13.6-25.5)
Bolivia	2012	19.0 (15.7-22.7)	21.3 (16.9-26.5)	15.9(12.8-19.7)	18.3 (15.1-22.0)	17.4 (12.7-23.4)	19.5 (14.3-26.0)
El Salvador	2013	18.1 (15.3-21.4)	19.1 (16.3-22.2)	16.6 (12.8-21.3)	22.8 (17.8-28.9)	15.2 (9.8-22.7)	32.2 (25.4-39.8)
Guyana	2010	41.4 (37.7-45.1)	47.2 (42.4-	35.7 (31.6-39.9)	10.1 (7.3-13.7)	10.2 (6.6-15.2)	10.0 (7.5-13.2)
Honduras	2012	16.0 (13.7-18.6)	14.3 (11.4-17.8)	17.1 (13.8-20.9)	22.5 (16.1-30.5)	18.7 (11.8-28.2)	25.3 (16.6-36.6)
Jamaica	2010	55.9 (53.6-58.1)	60.8 (57.2-64.3)	51.1 (45.9-56.3)	8.2 (5.9-11.3)	8.0 (4.8-12.9)	8.5 (5.9-12.0)
Peru	2010	29.5 (26.3-33.0)	31.7 (27.6-36.1)	27.4 (22.8-32.6)	14.0 (10.3-18.7)	14.9 (10.3-21.0)	12.9 (9.0-18.1)
EMR							
Lebanon	2011	27.3 (19.1-37.4)	35.6 (26.0-46.4)	20.2 (12.6-30.7)	7.1 (4.6-10.7)	9.0 (4.9-16.0)	4.1 (1.9-8.8)
Syria	2010	7.3 (5.4-9.7)	11.0 (8.1-14.7)	3.4 (2.6-4.6)	3.8 (1.6-8.8)	2.8 (1.0-7.5)	7.4 (2.7-18.4)
WPR							
Cambodia	2013	10.1 (8.3-12.3)	15.1 (12.5-18.1)	4.7 (3.6-6.3)	18.8 (13.4-25.8)	20.4 (14.3-28.1)	13.6 (7.2-23.9)
Fiji	2010	16.5 (14.0-19.3)	21.9 (18.3-26.0)	11.2 (8.1-15.3)	13.8 (10.2-18.4)	15.6 (10.8-21.8)	10.3 (5.7-17.9)
Kiribati	2011	32.0 (28.4-35.7)	45.9 (40.5-51.3)	19.8 (15.4-24.9)	25.9 (21.9-30.3)	26.3 (20.6-33.1)	25.0 (19.1-32.1)
Malaysia	2012	8.9 (7.8-10.1)	11.2 (9.8-12.8)	6.5 (5.6-7.5)	8.4 (6.7-10.6)	8.9 (6.7-11.6)	7.6 (5.1-11.3)
Mongolia	2013	8.9 (7.0-11.4)	10.9 (8.3-14.1)	7.0 (5.2-9.4)	4.7 (3.3-6.7)	3.4 (1.8-6.3)	6.6 (4.5-9.5)
Philippines	2011	23.5 (20.1-27.1)	29.0 (24.6-33.9)	17.9 (14.8-21.6)	24.0 (18.9-30.2)	21.1 (16.0-27.3)	28.7 (21.8-36.8)
Samoa	2011	36.7 (30.5-43.4)	45.2 (38.7-52.0)	27.7 (22.3-33.9)	12.1 (9.4-15.5)	7.7 (4.7-12.3)	18.8 (14.4-24.1)
Solomon Islands	2011	21.8 (17.3-27.1)	27.6 (21.2-35.0)	14.2 (10.6-18.8)	16.2 (11.7-21.9)	13.0 (8.4-19.5)	23.5 (17.2-31.2)
Tonga	2010	18.4 (16.0-21.0)	17.6 (14.7-21.0)	19.1 (16.1-22.5)	13.1 (9.7-17.3)	13.4 (9.0-19.6)	12.7 (8.3-18.9)
Vanuatu	2011	8.1 (5.2-12.3)	10.1 (6.6-15.2)	5.6 (3.3-9.4)	6.9 (3.7-12.7)	6.5 (1.9-19.8)	7.7 (1.3-33.9)
Vietnam	2013	24.9 (22.0-28.1)	33.3 (28.8-38.0)	17.6 (14.9-20.8)	8.8 (6.8-11.4)	9.2 (6.3-13.0)	8.3 (5.5-12.3)

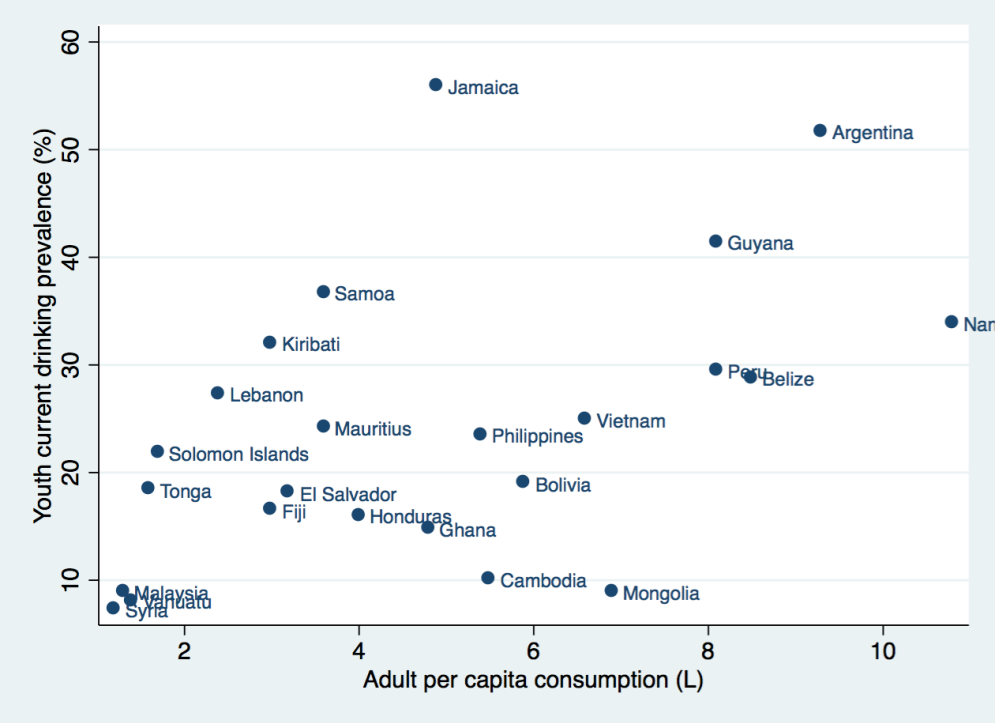
AFR = African region of the WHO, AMR = Region of the Americas, EMR = Eastern Mediterranean region, WPR = Western Pacific region

Figure 2. Binge drinking prevalence among current drinkers, by sex and WHO region



AFR = African region of the WHO, AMR = Region of the Americas, EMR = Eastern Mediterranean region, WPR = Western Pacific region

Figure 3. Youth alcohol consumption vs. adult per capita consumption, current and binge drinking



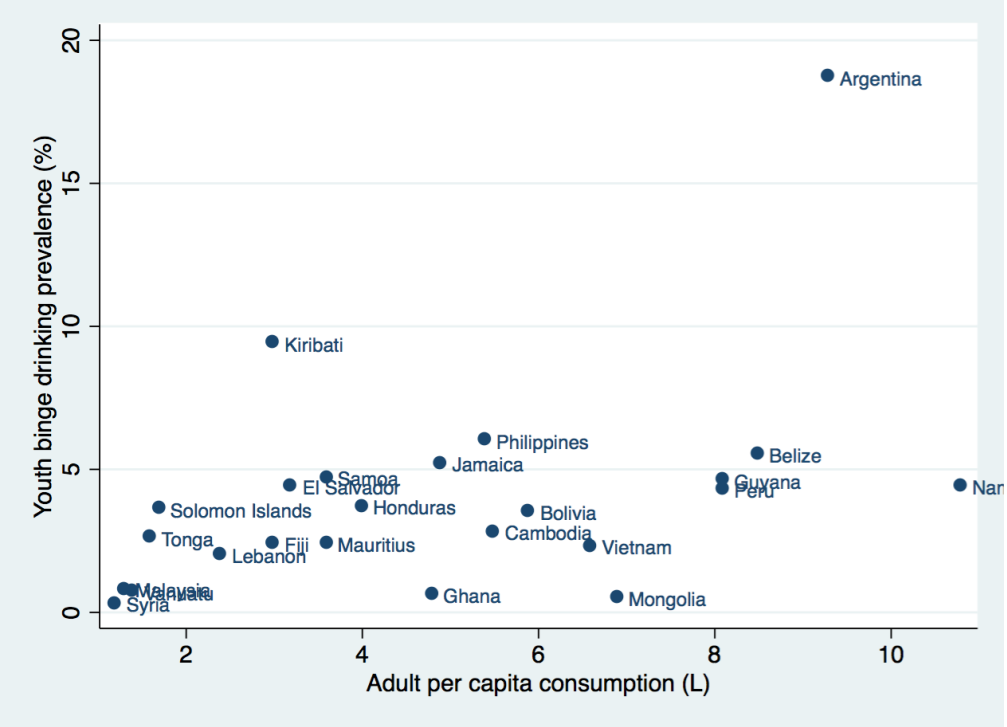


Table 1.3: Average age of initiation, total and by sex

Country by WHO region	Average age of initiation, years		
	Total	**Males**	**Females**
AFR			
Ghana	10.4	10.5	10.3
Mauritius	12.2	12.0	12.3
Rodrigues	11.7	11.4	12.0
Namibia	12.6	12.7	12.6
AMR			
Argentina	12.1	11.8	12.4
Belize	11.8	11.4	12.2
Bolivia	12.9	12.9	13.1
El Salvador	12.0	11.8	12.2
Guyana	11.3	11.0	11.7
Honduras	11.8	11.7	11.9
Jamaica	11.2	10.9	11.6
Peru	12.5	12.3	12.7
EMR			
Lebanon	10.7	10.4	11.2
Syria	10.0	9.9	10.2
WPR			
Cambodia	15.3	15.4	14.9
Fiji[a]	N/A	N/A	N/A
Kiribati	12.5	12.3	12.9
Malaysia	12.1	12.1	12.2
Mongolia	13.1	12.7	13.5
Philippines	13.1	13.0	13.3
Samoa	9.8	9.7	10.0
Solomon Islands	12.1	12.4	11.7
Tonga	11.6	11.4	11.8
Vanuatu	11.9	11.9	12.0
Vietnam	13.0	12.8	13.3

[a] Fiji did not ask age of initiation in the survey

AFR = African region of the WHO, AMR = Region of the Americas, EMR = Eastern Mediterranean region, WPR = Western Pacific region

PAPER 2

Alcohol, violence, and injury in young people in low- and middle-income countries

ABSTRACT

Introduction

Alcohol use is the leading risk factor for mortality in 15-24 year olds globally, yet little is known about alcohol consumption patterns and their association with harm in youth in low- and middle-income countries.

Methods

Data were obtained from the World Health Organization's Global School-based Student Health Survey (GSHS), designed to measure and assess the behavioral risk and protective factors in 10 key areas that cover the leading causes of morbidity and mortality worldwide among 13-17 year-old students, primarily in LMIC settings. Current drinking was defined as having at least one drink of alcohol, but not more than three for females and four for males in one day, in the past 30 days; binge drinking was defined as four or more drinks for females and five or more drinks for males on at least one day in the past 30 days. A series of logistic regression models were used to assess the association between current and binge alcohol consumption and past year fighting and serious injury.

Results

More than 30% of current non-drinking students reported having been in a physical fight in the past year, contrasting with 52% of current drinkers who did not report binge drinking and 56% who reported binge drinking. Similarly, 44% of non-drinking students reported having been seriously injured in the past year, increasing to 59% of current drinkers and 62% of binge drinkers. Males reported greater prevalence of fighting and injury across the majority of consumption levels; however, females frequently experienced a steeper increase in odds of fighting and injury between non-drinkers, current drinkers, and binge drinkers.

Discussion

Young people in LMICs are at significant risk of violence and injury, and increasing levels of alcohol consumption increase this risk significantly, with males shouldering the greater burden. Females drinking at similar levels to males may be at greater risk of violence and serious injury. As LMICs are poised to benefit from ongoing economic development, a healthy workforce is necessary; preventing and reducing alcohol use among youth should be a prime target for intervention.

INTRODUCTION

The UN Secretary-General's recent *Global strategy for women's, children's, and adolescent's health (2016-2030)* defines three overarching objectives: to survive (end preventable deaths), thrive (ensure health and well-being), and transform (expand enabling environments).[141] While great gains have been made in infant and under-5 survival, adolescent health has not received the same attention and investment, and progress has been less significant.[142] The leading causes of death in youth ages 10-24 are intentional and unintentional injuries, including road injuries, self-harm, drowning, and interpersonal violence, all of which are highly preventable and call for greater investment in reducing known adolescent risk factors including alcohol use, which bears a strong association.[45,143-146] Alcohol use is the leading risk factor for mortality in 15-24 year olds globally, a position that has remained unchanged since 1990 according to the Global Burden of Disease Study (GBD).[143] It is also now the fifth leading risk factor for mortality in 10-14 year olds, an increase from sixth in 1990.[143]

There is a well-established causal association between alcohol and violence.[51] Youth are more likely to be involved with violent behavior both as perpetrators and as victims, and, while less studied than adults, alcohol use is associated with both roles, despite it being an illegal product for many (depending on legal age of consumption).[53-56] Injury in youth related to alcohol use may result from intentional violent acts, such as fighting, or may be unintentional as from falls or motor vehicle crashes. Emergency department (ED) studies have found that injuries with higher severity and those which were intentional versus non-intentional tend to be alcohol-related.[48-50] In a retrospective review, Sindelar et al. found that almost 50 percent of ED trauma admissions among 13-19 year olds were alcohol-positive compared to only five percent of general admissions.[50]

Acute alcohol consumption increases risks for violence- and injury-related morbidity and mortality more so than chronic use,[45,147] but certain drinking patterns are more predictive of injury than others.[28,148] "Drinking patterns" refer to aspects of alcohol use beyond volume, such as types of beverages consumed, settings or cultural influences (e.g., sporting events, religion), and heavy drinking or "binge" episodes.[149] The National Institutes of Health's National Institute on Alcohol Abuse and Alcoholism (NIAAA) defines binge drinking as consuming 5 or more alcoholic beverages for males and 4 or more drinks for females on one occasion; a standard drink contains about 14 grams of pure alcohol, which is found in 12 ounces (oz) of beer, 5 oz of wine and 1.5 oz of distilled spirits. Binge drinking, common among youth, is a pattern associated with greater health risk behaviors and injury than for non-drinkers, but also for those who drink less than the binge thresholds.[44] Both frequency and intensity (number of drinks consumed during the binge) of binge drinking have been found to exhibit dose-response relationships with risk of injury.[45-47]

In high-income countries (HICs), lower socioeconomic status (as measured by income, education or employment), is associated with less alcohol use; however, the harms incurred are greater due to larger volume per drinking occasion, greater cultural acceptance of heavier drinking and/or less access to resources such as health care (mental and physical).[3] Similarly, adult per capita consumption (APC) of alcohol is lower in LMICs versus in HICs, but drinkers in LMICS are more likely than those in HICs experience a greater burden of harm due to heavier drinking per episode and limited resources leading to fewer opportunities for treatment and interventions.[150-152]

Although youth in LMICs tend to have higher alcohol abstention rates than both adults in LMICs and youth in HICs,[29] those who do drink and those around them may be at an increased

risk of violence and injury; however, little is known about this association. It is also unknown how the patterns by which youth in LMICs drink contribute to their burden of violence and injury. Young people in LMICs experience a greater burden of violence and injury than in HICs,[143,153] but the bulk of the literature on risk factors and prevention is from HICs.[146] This study will use the alcohol and injury modules of a World Health Organization-supported survey to explore the association of alcohol use among young people in LMICs with two of the most common causes of morbidity and mortality in youth, interpersonal violence and serious injury. We will explore this association by alcohol consumption patterns, looking at non-drinkers, drinkers who do not binge drink, and those who do binge drink, and analyze differences by sex.

METHODS

Data source

The Global School-based Student Health Survey (GSHS) was developed by the WHO in collaboration with United Nations' UNICEF, UNESCO, and UNAIDS, and with technical assistance from the U.S. Centers for Disease Control and Prevention (CDC). It was designed to measure and assess the behavioral risks and protective factors in 10 key areas that cover the leading causes of morbidity and mortality worldwide among 13-17 year-old students, primarily in LMIC settings: alcohol use, dietary behaviors, drug use, hygiene, mental health, physical activity, protective factors, sexual behaviors, tobacco use, and violence/unintentional injury. It is implemented at a country level, uses a standardized cluster sample selection process to collect age, sex, and country-specific grade levels, and is designed to be self-completed by students with pen and paper in one class period. The first stage of the two-stage sampling design uses a probability proportionate to size method to select schools from a list of all schools. The second stage targets classrooms within the schools with students of the target age groups; all students

within the chosen class are eligible to participate. Completed data sheets are sent to CDC for processing and editing of data; the same edits are used in all countries to ensure comparability across countries. Data files are made public two years after a country approves the final report, and contain de-identified information. Final data files contain weighted data, allowing results to be nationally representative. Between 2003 and 2015, at least 94 countries completed a GSHS (450,000 students).[132]

Study population

A time period of 2010-2015 was chosen as the study period, as older data may not be as relevant due to changes in population demographics, national income or other unknown factors. Sixty-four countries and one autonomous region posted public data from the GSHS between 2010-2015, but not all completed the alcohol module. The Cook Islands, Niue, Nauru, and Tuvalu each only had one stratum with one primary sampling unit (PSU) for the entire survey, which does not allow for parameter estimation using survey methods; these countries were not included. Rodrigues is an autonomous region within Mauritius. It fielded its own survey, results from which were included. Six countries (five in the Region of the Americas [AMR] and one in the Western Pacific Region [WPR]) were identified under the World Bank classification as high-income and were excluded. Thus, 25 datasets from 2010-2015 for 24 countries and one autonomous region were included in the analyses for this paper (Table 2.1). Sample sizes varied from 1,119 (Vanuatu) to 28,368 (Argentina), with a median of 2,286.

Measures

Two questions from the GSHS Alcohol Use module on (1) frequency and (2) quantity will be used to define current and non-drinkers[1] and to create a 3-level alcohol use independent

[1] While these students are called "non-drinkers", they technically have only responded "0" to drinking in the past 30 days.

variable (Table 2.2, 2.3). Current drinking is defined as a response of at least 1-2 days in the past 30 days to the frequency question (non-drinkers report 0 days). Current drinkers with a response of less than or equal to 4 for males and less than or equal to 3 for girls on the quantity question will be categorized as "current drinking without binge drinking." "Current binge drinking" will be defined as current drinkers who report a response of 5 or more for boys and equal to or greater than 4 for girls to the question on quantity.

Two outcome measures were included from the Violence and Unintentional Injury module in the GSHS (Table 2.2, 2.3): physical fighting (the most common manifestation of youth violence) and serious injury. GSHS provides students with definitions of (1) physical fighting: A physical fight occurs when two students of about the same strength or power choose to fight each other, and (2) serious injury: An injury is serious when it makes you miss at least one full day of usual activities (such as school, sports, or a job) or requires treatment by a doctor or nurse. The answers will be dichotomized to indicate any versus no times reported for each outcome in the past 12 months.

Bivariate logistic regression was conducted first for the three-level exposure variable and the physical fighting outcome. Models were then adjusted for respondents' demographic factors (age, sex). An age/sex interaction term was also evaluated to explore the possibility of effect modification. Bivariate logistic regression was then conducted for the three-level exposure variable and the seriously injured outcome followed by adjustment by age and by sex. All analyses were conducted using Stata/IC 14.2, using appropriate survey methods to account for the complex design.

RESULTS

Data from the GSHS study countries represented 113,389 students from 24 countries and one autonomous region (Table 2.1). Prevalence of students reporting engaging in a physical fight one or more times in the past 12 months ranged from 10.5 percent in Cambodia (95%CI: 9.2-12.0) to 68.7 percent in Samoa (95%CI: 65.2-72.1), with an average of 38.3 percent. Males were more likely to report engaging in at least one fight in the past year in all countries except Tonga; however, the difference in Tonga was not statistically significant (p=0.3). Prevalence of sustaining a serious injury in the past year ranged from 20.1 percent in Cambodia (95%CI: 17.5-23.0) to 72.7 percent in Ghana (95%CI: 66.9-77.8). Males were again more likely to report past year serious injury, except in Ghana (p=0.5) and Tonga (p=0.05).

Interpersonal violence, by alcohol consumption level

Prevalence of students reporting engaging in a physical fight one or more times in the past 12 months was more common among current drinkers who did not binge drink and current drinkers who did binge drink than nondrinkers across all countries (Table 2.4). Prevalence of fighting among nondrinkers ranged from 8.9 percent in Cambodia (95%CI: 7.6-10.5) to 56.8 percent in Samoa (95%CI: 52.8-60.7). These two countries also had the lowest and highest rates for current drinkers who did not report binge drinking (Cambodia—19.9, 95%CI: 14.7-26.5; Samoa—82.9, 95%CI: 79.0-86.2) and for current drinkers who did report binge drinking (Cambodia—22.5, 95%CI: 12.4-37.2; Samoa—89.5, 95%CI: 79.0-95.1). Adjusted odds ratios for current drinkers who did not binge compared to non-drinkers ranged from 1.5 in Namibia to 3.6 in Cambodia. For current binge drinkers (also using non-drinkers as the reference), AORs ranged from 2.2 again in Namibia to 6.6 in Samoa.

Mauritius had the lowest prevalence of reporting past year fighting in the AFR region for nondrinkers (28.1, 95%CI: 22.3-34.7); however, Namibia reported the lowest for current drinkers

who did not binge (36.7%, 95%CI: 32.8-40.8) and binge drinkers (44.0, 95%CI: 34.3-54.1). Ghana had the highest rates for nondrinkers and current drinkers who did not binge, ranging from 43.4%, 95%CI: 38.3-48.7 to 68.2%, 95%CI: 60.8-74.9, while Rodrigues had the highest prevalence of binge drinkers who reported fighting (69.5%, 95%CI: 50.7-83.5). In the AMR region, El Salvador had the lowest prevalence among nondrinkers of past year fighting (21.8%, 95%CI: 17.6-26.8), with Argentina reporting the lowest for current drinkers who did not binge (39.5%, 95%CI: 37.3-41.7) and Honduras the lowest for binge drinkers (47.7%, 95%CI: 39.4-56.1). Jamaica had the highest rate of past year fighting among nondrinkers (38.5%, 95%CI: 32.7-44.8) and current drinkers who did not binge (57.3%, 95%CI: 50.5-63.8), while Peru reported the highest among binge drinkers (63.9%, 95%CI: 56.7-70.6). As mentioned above, Cambodia and Samoa had the lowest and highest prevalence, respectively, in the WPR region.

Interpersonal violence, by alcohol consumption level and sex

An analysis of past year fighting by consumption level and by sex identified a similar pattern of stepwise increases in prevalence from non-drinkers to current drinkers to binge drinkers, with females experiencing significantly lower prevalence rates of fighting in most countries and at most consumption levels (Table 2.5). The lowest prevalence of past year fighting was for non-drinking males in in Cambodia (9.5%, 95%CI: 7.6-11.7) and non-drinking females in Vietnam (8.4%, 95%CI: 6.8-10.5). The highest prevalence was for binge drinking males (83.6%, 95%CI: 58.7-94.8) and females in Samoa (91.6%, 95%CI: 79.9-96.7). In 14 of the countries, females who were current drinkers had a greater AOR (adjusted for age) of fighting compared to non-drinkers than males; however, differences were not significant. In 13 of the countries, females who were binge drinkers reported greater AORs of fighting compared to non-drinkers than males, but again differences were not statistically significant.

Serious injury, by alcohol consumption level

Prevalence of students reporting a past-year serious injury was lower for non-drinkers than for both current drinkers who did not report binge drinking and current drinkers who reported binge drinking. For non-drinkers, prevalence of serious injury ranged from 17.9 percent in Cambodia (95%CI: 15.4-20.8) to 74.0 percent in Samoa (95%CI: 70.2-77.4) (Table 2.6). Prevalence for current drinkers who did not binge drink was again lowest and highest in Cambodia and Samoa (Cambodia–34.2%, 95%CI: 26.3-42.9; Samoa–95.9%, 95%CI: 91.3-98.1). Students in Honduras reported the lowest prevalence of serious injury among binge drinkers (34.0%, 95%CI: 24.4-45.1), while students in Samoa reported the highest (96.7%, 95%CI: 87.0-99.2). Adjusted odds ratios for current drinkers who did not report binge drinking compared to non-drinkers ranged from a low of 1.6 in Mauritius, Rodrigues, and Malaysia to a high of 7.8 in Samoa. Current drinkers who reported binge drinking were even more likely to report a serious injury, with AORs greater than current drinkers compared to non-drinkers in the majority of countries.

Looking at results by WHO region, in the AFR, Mauritius had the lowest rates of past year injury across all three drinking levels (35.2%-48.7%-57.1%). In the AMR, Argentina reported the lowest prevalence for non-drinkers (26.4%, 95%CI: 24.6-28.3) and current drinkers who did binge (38.0%, 95%CI: 35.5-40.6); however, Honduras reported the lowest among binge drinkers (34.0%, 95%CI: 24.4-45.1). Jamaica reported the highest prevalence across all three drinking levels (49.0%-65.2%-80.5%) In the EMR region, Lebanon reported lower rates among non-drinkers and current drinkers who did not binge, but Syria reported lower rates for binge drinkers (63.4%, 95%CI: 25.6-89.7). Cambodia had the lowest prevalence across all three

drinking levels in the WPR region (17.9%-34.1%-36.0%) and Samoa the highest (74.0%-95.9%-96.7%).

Serious injury, by alcohol consumption level and sex

Step-wise increases were seen in prevalence of past year serious injury from non-drinkers to current drinkers and to most binge drinking levels, with females predominantly reporting lower rates than males (Table 2.7). Female binge drinkers reported greater prevalence of injury than male binge drinkers in six countries: Bolivia, Honduras, Cambodia, Fiji, Malaysia, and Solomon Islands, but all had overlapping confidence intervals. Statistically significant AORs for male current drinkers compared to non-drinkers ranged from 1.4 in Mauritius and Jamaica to 9.8 in Samoa. For female current drinkers compared to non-drinkers significant AORs ranged from 1.5 in Guyana to 6.1 in Samoa. For male binge drinkers compared to non-drinkers, significant AORs ranged from 1.7 in the Philippines to 10.0 in Rodrigues, while for females AORs ranged from 1.6 in Mauritius to 6.4 in Cambodia.

DISCUSSION

Young people in LMICs experience a significant burden of interpersonal violence and injury associated with alcohol consumption. Over 30 percent of non-drinking students across all study countries report having been in a physical fight in the past year; however, this jumps significantly to 52 percent of current drinkers who did not report binge drinking in the past month and 56 percent of those who reported binge drinking. Similarly, 44 percent of non-drinking youth reported having been seriously injured in the past year, increasing to 59 percent and 62 percent for current drinkers and current binge drinkers, respectively.

The relationships between alcohol use, fighting, violence, and sex deserves more attention. As expected, male and female students reported past year fighting and injury

differently in most study countries. Females reported statistically significantly lower rates of fighting compared to males in 19 of 24 countries and of serious injury in 22 of 25 countries. Tonga was the only country where females reported greater rates of both, with serious injury achieving borderline statistical significance (p=0.05). While females report lower rates of interpersonal violence and injury, the increase with level of alcohol consumption is of some concern. In Honduras, 20 percent of females reported past year fighting versus 37 percent of males; however, only 15 percent of non-drinking females reported past year fighting; females who reported binge drinking had 7.1 greater odds of past year fighting (52.4 percent) than non-drinkers. In Cambodia, the overall rate of past year serious injury was 20 percent, the lowest of any country. For non-drinkers, prevalence of serious injury was 20 percent for males and 16 percent for females. However, that increased to almost 53 percent in females who reported binge drinking at least once in the past 30 days (AOR: 6.5), which was also significantly higher than males (33.3%, AOR=2.0). While Cambodia reported low prevalence for both outcome variables at all levels of alcohol consumption among both males and females, 1 in 6 non-drinking females reported a serious injury compared to more than 1 in 2 binge drinking females.

Studies show that despite women's higher abstention rates and lower heavy drinking prevalence, there is still a strong association with violence and injury.[152] While women tend to binge drink less than men, Popovici et al. found that women binge drinkers were more likely to be victims of predatory crime than males at the same consumption levels.[56] Da Silva et al. found that adult women in LMICs were less likely to drink overall, but more likely to engage in binge drinking (48 percent) than those in developed countries (38 percent), and were also more likely to experience violence-related injuries.[152] Our results support these findings and add to the

concern that women, especially younger women and women in lower income countries, are beginning to drink more, which could lead to greater rates of violence and injury.[151]

Increased investment into child and adolescent health has great implications for the global workforce; countries may reap a "demographic dividend" as the ratio of working to dependent populations increases.[154] Injuries in young people have a number of negative effects beyond the injury itself, including as many as 3.7-4 million missed days of school globally.[153] Serious injuries can also lead to temporary or chronic disability, as well as pain and depression, all of which may interfere with opportunities for full employment and lead to un- or under-employment and poverty. Disfigurement from a serious injury may also serve as a basis for discrimination and an inability to fully participate in society. Finally, injury-related mortality has a greater impact on youth due to the larger number of potential years of life lost. Alcohol consumption, with its association with greater prevalence of violence and injury, is an important target for intervention in youth, including youth in LMICs. Reporting only overall rates of violence and injury masks these more vulnerable populations of young people who are drinking regularly, especially the heavier drinkers.

Limitations

As with any cross-sectional survey analysis, a causal relationship between alcohol consumption and rates of violence and injury among youth cannot be determined. However, the fact that numerous studies from HICs have arrived at similar conclusions suggests that such a relationship exists in LMICs as well.[51]

The GSHS only collects age, sex, and grade level, leaving out key demographic factors that could be helpful in understanding risk and protective profiles for youth. Alcohol consumption and harm have been found to be associated with income, race/ethnicity, religion,

and a number of other factors that could further inform the associations between violence and injury and alcohol consumption.[75]

When analyzing subpopulations, sample sizes can become very small so as to lead to results that lack precision. In some cases, analyses may not even be possible as was the case with some of the binge drinking consumption levels for females for both outcomes due to samples being close to zero. However, our prevalence estimates and AORs comparing current drinkers who did not binge drink to non-drinkers were statistically significant and greater for both males and females across all countries, indicating that some degree of alcohol consumption is a substantial risk for experiencing violence and injury.

Conclusion

Young people in LMICs experience a significant amount of interpersonal violence and serious injury, with males shouldering the greater burden; there appears to be a dose-response relationship with increasing alcohol consumption. Future research should include population-based longitudinal studies of youth, alcohol consumption, and violence and injuries, specifically focusing on gender differences. Additional demographic information such as religiosity and individual-level income would also be useful in understanding important risk and protective factors and informing public health policy interventions.

In 2010, the WHO adopted the *Global Strategy to Reduce the Harmful Use of Alcohol*, based on alcohol's status as a leading preventable risk factor for ill health and a significant contributor to family and social disruption.[12] The findings in this paper point to a need not only to improve surveillance and reporting of youth drinking and related harms in LMICs, but also to focus global strategies particularly on youth and build a stronger global evidence base regarding

the best ways of reducing and preventing alcohol use and problems among young people in LMICs.

Table 2.1. Prevalence of past year fighting and serious injury, total and by sex

Country by WHO region (N)	Date of survey	Past year fighting[a]			Past year serious injury[b]		
		Total	Male	Female	Total	Male	Female
		% (95%CI)			% (95%CI)		
AFR							
Ghana (N=1,471)	2012	48.4 (44.2-52.5)	50.5 (44.0-56.9)	46.2 (41.4-50.9)	72.7 (66.9-77.8)	72.1 (66.2-77.3)	73.2 (66.7-78.8)
Mauritius (N=2,122)	2011	33.9 (27.6-40.8)	47.7 (42.1-53.4)	20.9 (17.6-24.7)	38.8 (33.7-44.2)	47.2 (43.1-51.4)	30.9 (26.4-35.7)
Rodrigues[c] (N=1,103)	2011	34.3 (30.5-38.4)	40.4 (34.4-46.6)	29.0 (25.6-32.7)	46.6 (42.5-50.7)	51.1 (45.9-56.3)	42.6 (37.2-48.3)
Namibia (N=4,208)	2013	32.5 (29.4-35.8)	38.5 (34.6-42.5)	27.0 (23.8-30.6)	53.8 (50.4-57.2)	59.3 (56.1-62.5)	48.7 (44.5-52.9)
AMR							
Argentina (N=26,525)	2012	34.1 (32.4-35.9)	44.7 (42.0-47.5)	24.1 (22.5-25.8)	33.6 (32.1-35.2)	42.4 (40.6-44.3)	25.3 (23.5-27.2)
Belize (N=2,028)	2011	34.8 (31.9-37.8)	42.6 (39.4-45.9)	27.7 (24.0-31.7)	45.0 (41.1-48.9)	50.1 (45.9-54.3)	40.4 (35.6-45.4)
Bolivia (N=3,491)	2012	32.9 (31.4-34.4)	44.4 (41.6-47.3)	21.2 (18.8-23.7)	49.3 (47.3-51.3)	54.8 (52.5-57.1)	42.8 (39.7-45.9)
El Salvador (N=1,817)	2013	26.2 (22.5-30.1)	33.7 (29.2-38.6)	17.9 (13.4-23.4)	36.0 (32.7-39.3)	42.3 (39.4-45.3)	28.9 (24.7-33.6)
Guyana (N=2,165)	2010	37.7 (34.3-41.1)	49.6 (45.8-53.5)	25.7 (21.9-30.0)	37.1 (34.0-40.3)	40.8 (36.5-45.2)	33.1 (29.5-36.9)
Honduras (N=1,683)	2012	28.1 (24.5-32.0)	37.1 (33.3-41.0)	19.6 (15.2-24.9)	35.6 (33.6-37.8)	42.6 (37.6-47.8)	29.8 (26.0-34.0)
Jamaica (N=1,511)	2010	50.2 (43.9-56.5)	58.1 (52.2-63.8)	41.0 (31.8-50.9)	59.5 (49.9-68.4)	63.2 (50.8-74.1)	54.2 (44.6-63.5)
Peru (N=2,723)	2010	37.8 (33.8-41.9)	52.9 (48.3-57.4)	22.2 (18.7-26.1)	49.5 (46.4-52.5)	54.5 (50.3-58.7)	44.4 (41.0-47.8)
EMR							
Lebanon (N=2,228)	2011	48.8 (46.0-51.7)	70.2 (67.3-72.9)	30.2 (27.0-33.6)	39.3 (35.9-42.8)	44.0 (39.6-48.5)	35.3 (32.3-38.4)
Syria (N=3,088)	2010	N/A	N/A	N/A	45.0 (41.4-48.6)	50.9 (46.4-55.4)	38.9 (34.8-43.2)

Table 2.1 (continued)

WPR							
Cambodia (N=3,638)	2013	10.5 (9.2-12.0)	11.2 (9.3-13.5)	9.6 (7.6-12.1)	20.1 (17.5-23.0)	22.5 (19.2-26.3)	17.5 (14.3-21.4)
Fiji (N=1,651)	2010	48.5 (43.9-53.0)	60.2 (53.4-66.7)	36.6 (30.6-43.0)	51.2 (45.6-56.7)	58.8 (49.5-67.4)	43.7 (37.6-49.9)
Kiribati (N=1,509)	2011	36.1 (31.9-40.5)	44.1 (39.3-48.9)	29.0 (24.4-34.0)	57.8 (52.6-62.8)	62.5 (56.5-68.0)	53.4 (48.1-58.5)
Malaysia (N=25,224)	2012	27.4 (26.0-28.7)	34.8 (33.2-36.4)	19.9 (18.4-21.4)	34.9 (33.6-36.3)	42.1 (40.6-43.7)	27.8 (26.4-29.3)
Mongolia (N=5,243)	2013	41.4 (39.7-43.2)	63.2 (60.4-65.9)	21.1 (19.6-22.7)	36.3 (34.3-38.4)	42.3 (39.3-45.3)	30.6 (28.4-33.0)
Philippines (N=5,135)	2011	36.6 (33.4-40.0)	42.8 (38.6-47.0)	30.6 (27.2-34.3)	48.2 (44.6-51.9)	54.3 (49.9-58.6)	42.3 (38.2-46.4)
Samoa (N=2,010)	2011	68.7 (65.2-72.1)	73.7 (69.1-77.9)	63.3 (58.4-68.0)	84.3 (80.8-87.3)	88.5 (84.9-91.3)	79.5 (74.8-83.5)
Solomon Islands (N=1,291)	2011	53.5 (45.3-61.5)	55.2 (45.9-64.3)	49.4 (38.2-60.7)	70.2 (61.1-78.0)	71.1 (60.4-80.0)	68.2 (59.0-76.3)
Tonga (N=2,078)	2010	49.2 (46.5-52.0)	47.8 (43.6-52.1)	50.7 (47.0-54.4)	62.7 (59.6-65.7)	59.5 (54.4-64.4)	65.6 (61.8-69.2)
Vanuatu (N=1,078)	2011	49.8 (41.7-58.0)	57.2 (47.6-66.4)	42.1 (32.9-51.9)	62.8 (55.1-70.0)	68.5 (61.4-74.8)	56.7 (45.7-67.2)
Vietnam (N=3,183)	2013	16.6 (14.4-19.0)	24.2 (21.1-27.6)	9.9 (8.0-12.2)	29.3 (27.1-31.7)	34.3 (31.5-37.1)	25.1 (22.6-27.7)
Total (mean)		38.3	46.9	29.8	48.0	52.8	43.2

[a] Defined as having been in one or more physical fights in the past year
[b] Defined as having sustained a serious injury in the past year
[c] Rodrigues is an autonomous region of Mauritius

Table 2.2. Core questions from GSHS, alcohol use, violence and unintentional injury

Indicator	Survey question	Responses
Alcohol Use module		
Frequency	During the past 30 days, on how many days did you have at least one drink containing alcohol?	0, 1-2, 3-5, 6-9, 10-19, 20-29, All 30 days
Quantity	During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink	I did not drink, 1, 2, 3, 4, 5 or more
Violence and Unintentional Injury module		
Fighting	During the past 12 months, how many times were you in a physical fight?	0 , 1, 2 or 3, 4 or 5, 6 or 7, 8 or 9, 10 or 11, 12 or more
Serious injury	During the past 12 months, how many times were you seriously injured?	0 , 1, 2 or 3, 4 or 5, 6 or 7, 8 or 9, 10 or 11, 12 or more

[a] A drink is defined as a glass of wine, a bottle of beer, a small glass of liquor, or a mixed drink
[b] A physical fight is defined as occurring when two students of about the same strength or power choose to fight each other
[c] A serious injury is defined as when it makes you miss at least one full day of usual activities (such as school, sports, or a job) or requires treatment by a doctor or nurse

Table 2.3. Alcohol use exposure variables and violence and injury outcome variables

Measures	Definitions	
Alcohol exposure variables		
Non-drinkers	**Frequency:** 0 days	
Current drinking		
	1-2 days	
Current drinking without binge drinking	1-2 days	**Quantity:** Males: 1, 2, 3, 4 Females: 1, 2, 3
Current drinking with binge drinking	1-2 days	Males: 5 or more Females: 4, 5 or more
Violence and injury outcome variables		
Past year fighting	1, 2 or 3, 4 or 5, 6 or 7, 8 or 9, 10 or 11, 12 or more times	
Past year serious injury	1, 2 or 3, 4 or 5, 6 or 7, 8 or 9, 10 or 11, 12 or more times	

Table 2.4. Prevalence and AORs of past year fighting[a] by current (past 30 days) drinking status

Country by WHO region	Nondrinkers	Current Drinkers Who Did Not Binge[a]		Current Drinkers Who Binge[b]	
	% (95%CI)	% (95%CI)	AOR (95%CI)	% (95%CI)	AOR (95%CI)
AFR					
Ghana	43.4 (38.3-48.7)	68.2 (60.8-74.9)	2.9 (2.0-4.2)	89.8 (58.7-98.2)	12.4 (1.5-102.2)
Mauritius	28.1 (22.3-34.7)	53.0 (42.6-63.1)	2.8 (2.0-3.9)	57.0 (34.9-76.6)	3.0 (1.0-8.7)
Rodrigues[c]	30.6 (26.3-35.2)	41.7 (35.4-48.3)	1.9 (1.3-2.6)	69.5 (50.7-83.5)	6.5 (2.7-15.4)
Namibia	28.7 (25.6-32.0)	36.7 (32.8-40.8)	1.5 (1.3-1.8)	44.0 (34.3-54.1)	2.2 (1.5-3.1)
AMR					
Argentina	24.8 (22.9-26.7)	39.5 (37.3-41.7)	2.2 (1.9-2.4)	48.7 (44.3-53.2)	3.4 (2.8-4.1)
Belize	26.5 (24.1-29.0)	51.4 (45.2-57.5)	3.0 (2.4-3.8)	65.2 (55.5-73.8)	5.8 (3.2-10.4)
Bolivia	27.8 (26.2-29.5)	54.9 (48.6-61.0)	3.4 (2.6-4.4)	57.4 (47.5-66.7)	4.5 (2.9-7.0)
El Salvador	21.8 (17.6-26.8)	41.5 (36.0-47.3)	2.4 (1.6-3.7)	50.7 (38.6-62.6)	4.7 (2.6-8.6)
Guyana	29.1 (26.3-32.1)	46.6 (42.7-50.6)	2.1 (1.7-2.5)	59.4 (50.2-67.9)	3.6 (2.4-5.6)
Honduras	23.7 (20.8-26.9)	45.1 (33.7-57.0)	3.2 (2.1-4.9)	47.7 (39.4-56.1)	4.1 (2.4-6.9)
Jamaica	38.5 (32.7-44.8)	57.3 (50.5-63.8)	2.2 (1.6-3.0)	63.1 (46.4-77.1)	2.8 (1.3-6.2)
Peru	31.4 (26.8-36.4)	51.0 (46.3-55.7)	2.4 (1.9-3.1)	63.9 (56.7-70.6)	4.2 (2.7-6.4)
EMR					
Lebanon	42.7 (39.7-45.9)	63.1 (55.7-70.0)	1.8 (1.4-2.4)	63.8 (49.9-75.7)	1.4 (0.6-2.9)
Syria	N/A	N/A	N/A	N/A	N/A
WPR					
Cambodia	8.9 (7.6-10.5)	19.9 (14.7-26.5)	3.6 (2.4-5.4)	22.5 (12.4-37.2)	5.4 (2.4-11.9)
Fiji	44.6 (39.3-49.9)	66.7 (50.1-80.0)	2.2 (1.0-4.7)	70.4 (50.9-84.6)	2.4 (1.1-5.4)
Kiribati	29.5 (24.7-34.9)	46.2 (40.3-52.3)	1.8 (1.4-2.4)	50.5 (40.6-60.5)	2.1 (1.2-3.8)
Malaysia	25.7 (24.4-27.0)	39.9 (36.7-43.2)	1.9 (1.6-2.1)	47.8 (38.0-57.7)	2.7 (1.7-4.1)
Mongolia	39.1 (37.4-40.9)	63.9 (58.8-68.7)	3.5 (2.6-4.6)	43.9 (30.1-58.7)	1.7 (0.8-3.7)
Philippines	32.4 (28.4-36.7)	45.9 (40.3-51.5)	1.8 (1.4-2.4)	55.7 (45.5-65.4)	3.1 (2.0-5.0)
Samoa	56.8 (52.8-60.7)	82.9 (79.0-86.2)	3.4 (2.8-4.2)	89.5 (79.0-95.1)	6.6 (2.7-15.9)
Solomon Islands	46.6 (39.3-54.0)	69.2 (58.9-78.0)	2.7 (2.0-3.6)	75.8 (54.5-89.1)	4.0 (1.8-9.1)
Tonga	43.6 (40.4-46.9)	66.8 (60.7-72.4)	2.6 (2.0-3.5)	65.8 (48.5-79.7)	2.5 (1.3-5.2)
Vanuatu	48.4 (40.3-56.5)	64.0 (49.9-76.0)	2.0 (1.1-3.8)	44.7 (11.2-83.8)	1.1 (0.2-5.5)
Vietnam	13.2 (11.2-15.6)	25.2 (20.9-30.2)	2.4 (1.9-3.0)	33.9 (20.4-50.5)	4.6 (2.5-8.4)

[a] Fighting is defined as occurring when two students of about the same strength or power choose to fight each other
[b] Consumed at least one drink, but less than 4 drinks for females or less than 5 drinks for males on at least one occasion in the past 30 days
[c] Consumed at least 4 drinks for females or at least 5 drinks for males on at least one occasion in the past 30 days
[d] Rodrigues is an autonomous region within Mauritius
AMR = African Region, AMR = Region of the Americas, EMR = Eastern Mediterranean Region, WPR = West Pacific Region
AOR = Adjusted Odds Ratio (nondrinkers is the reference category)
N/A = Syria did not ask this question in their survey

Table 2.5. Prevalence and AORs of past year fighting[a] by alcohol consumption level and by sex

Country by WHO region	Male					Female				
	Non-drinkers	Current Drinkers Who Did Not Binge[b]		Current Drinkers Who Binge[c]		Non-drinkers	Current Drinkers Who Did Not Binge		Current Drinkers Who Binge	
	% (95%CI)	% (95%CI)	AOR (95%CI)	% (95%CI)	AOR (95%CI)	% (95%CI)	% (95%CI)	AOR (95%CI)	% (95%CI)	AOR (95%CI)
AFR										
Ghana	46.2 (38.6-54.0)	66.9 (57.0-75.4)	2.5 (1.6-4.0)	71.2 (28.6-93.9)	3.6 (0.3-41.4)	41.1 (34.4-48.2)	70.1 (58.2-79.8)	3.5 (1.8-6.5)	–	–
Mauritius	40.7 (35.4-46.3)	69.5 (57.3-79.5)	3.2 (1.9-5.3)	58.7 (29.7-82.6)	2.0 (0.6-6.8)	16.9 (14.4-19.8)	34.7 (27.5-42.6)	2.4 (1.6-3.6)	54.6 (27.7-79.1)	5.2 (1.4-18.7)
Rodrigues[d]	37.4 (31.2-44.1)	45.7 (35.5-56.3)	1.8 (1.1-2.8)	75.3 (46.4-91.5)	7.9 (1.9-33.0)	24.5 (19.9-29.8)	38.6 (31.1-46.7)	2.0 (1.2-3.3)	63.4 (36.5-83.9)	5.4 (1.7-17.2)
Namibia	33.7 (29.8-37.8)	43.3 (37.5-49.2)	1.7 (1.3-2.2)	48.0 (39.5-56.6)	2.2 (1.5-3.3)	25.0 (21.7-28.6)	29.1 (24.9-33.6)	1.4 (1.1-1.7)	41.2 (24.7-59.9)	2.3 (1.1-5.0)
AMR										
Argentina	33.9 (31.2-36.6)	52.0 (48.4-55.5)	2.3 (2.0-2.7)	59.7 (52.4-66.7)	3.2 (2.4-4.2)	16.6 (14.5-18.9)	27.4 (24.6-30.3)	2.0 (1.6-2.5)	39 (35.6-42.6)	3.5 (2.8-4.3)
Belize	32.8 (28.6-37.2)	61.6 (55.7-67.2)	3.5 (2.5-4.8)	71.0 (57.0-81.9)	5.5 (2.2-13.7)	21.5 (18.7-24.5)	40.0 (32.8-47.7)	2.6 (1.9-3.6)	59.5 (44.9-72.6)	5.8 (3.4-10.0)
Bolivia	39.1 (35.8-42.5)	62.0 (52.8-70.4)	2.8 (1.8-4.4)	70.6 (58.4-80.4)	4.6 (2.6-8.0)	16.6 (14.3-19.2)	44.5 (35.1-54.4)	4.3 (3.1-6.0)	40.6 (29.8-52.4)	4.3 (2.5-7.5)
El Salvador	28.7 (24.1-33.7)	49.3 (41.0-57.6)	2.4 (1.6-3.5)	68.1 (47.5-83.4)	5.3 (2.2-12.8)	14.9 (10.2-21.2)	29.8 (22.0-38.9)	2.5 (1.2-5.1)	41.0 (25.1-59.0)	4.5 (2.0-10.5)
Guyana	42.9 (37.0-49.1)	55.4 (50.4-60.3)	1.7 (1.2-2.4)	60.1 (48.1-71.0)	2.3 (1.3-4.1)	18.9 (16.1-22.1)	35.7 (30.7-41.1)	2.5 (2.0-3.0)	52.8 (37.3-67.8)	4.8 (2.6-8.9)
Honduras	33.5 (29.8-37.3)	57.9 (47.3-67.8)	3.1 (1.9-4.9)	44.0 (27.3-62.2)	1.9 (0.8-4.6)	14.9 (11.3-19.3)	34.9 (21.8-50.8)	3.3 (1.9-5.6)	52.4 (38.7-65.8)	7.1 (3.3-15.0)
Jamaica	50.8 (43.5-58.0)	61.8 (55.0-68.2)	1.7 (1.1-2.5)	62.9 (28.1-88.0)	1.8 (0.3-9.1)	27.0 (19.3-36.4)	51.4 (44.0-58.7)	2.9 (2.0-4.3)	63.3 (33.6-85.5)	4.8 (1.7-13.9)
Peru	46.2 (40.3-52.1)	65.7 (59.4-71.6)	2.3 (1.7-3.2)	69.3 (58.5-78.3)	2.7 (1.6-4.6)	16.8 (13.6-20.7)	33.9 (26.9-41.5)	2.5 (1.7-3.9)	56.6 (44.2-68.2)	6.7 (3.9-11.6)
EMR										
Lebanon	64.7 (61.7-67.7)	80.0 (72.8-85.7)	2.2 (1.5-3.2)	70.4 (52.8-83.5)	1.3 (0.6-2.9)	27.5 (24.0-31.3)	38.6 (33.5-44.1)	1.6 (1.2-2.1)	34.0 (7.8-75.7)	1.2 (0.2-7.8)
Syria	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WPR										
Cambodia	9.5 (7.6-11.7)	20.1 (13.3-29.0)	3.8 (2.1-6.8)	23.5 (12.5-39.8)	6.1 (2.7-13.6)	8.8 (6.5-11.6)	19.5 (11.9-30.3)	2.9 (1.4-6.2)	17.0 (5.0-44.7)	2.9 (0.7-12.1)
Fiji	56.3 (49.5-62.8)	74.7 (57.6-86.5)	2.3 (1.0-5.2)	78.7 (52.2-92.6)	2.9 (1.1-8.2)	34.5 (28.0-41.7)	52.3 (36.1-68.0)	2.1 (1.0-4.6)	46.6 (15.2-80.9)	1.7 (0.3-8.7)
Kiribati	36.1 (29.6-43.1)	50.0 (42.7-57.2)	1.7 (1.2-2.5)	58.5 (46.1-70.0)	2.4 (1.1-4.9)	26.0 (21.3-31.3)	38.8 (32.0-46.2)	2.0 (1.4-2.8)	33.9 (18.2-54.3)	1.6 (0.6-4.3)
Malaysia	33.0 (31.4-34.6)	45.4 (41.4-49.5)	1.8 (1.6-2.1)	46.0 (35.3-57.1)	2.0 (1.3-3.2)	18.8 (17.4-20.3)	30.5 (26.6-34.7)	1.9 (1.6-2.3)	51.3 (32.0-70.3)	4.8 (2.3-10.3)
Mongolia	61.1 (58.2-63.9)	78.7 (72.1-84.1)	3.1 (2.2-4.3)	76.4 (39.8-94.0)	2.4 (0.4-13.1)	19.5 (18.3-20.8)	42.2 (32.3-52.7)	4.0 (2.6-6.0)	18.5 (4.6-51.7)	1.3 (0.3-6.2)
Philippines	39.4 (34.0-45.1)	47.4 (41.6-53.3)	1.6 (1.1-2.1)	60.1 (49.6-69.7)	3.0 (1.8-4.9)	26.9 (23.4-30.8)	43.2 (36.2-50.4)	2.2 (1.6-3.0)	50.5 (35.4-65.5)	3.3 (1.8-6.0)
Samoa	62.5 (57.1-67.5)	84.5 (81.1-87.3)	3.3 (2.7-4.1)	83.6 (58.7-94.8)	3.1 (0.8-11.7)	53.6 (48.5-58.6)	80.2 (70.3-87.3)	3.4 (2.1-5.6)	91.6 (79.9-96.7)	9.0 (3.1-26.4)
Solomon Islands	49.1 (40.4-57.7)	68.6 (56.3-78.7)	2.4 (1.6-3.4)	78.2 (56.6-90.8)	4.1 (1.7-10.1)	43.1 (32.6-54.2)	70.9 (56.4-82.1)	3.5 (1.9-6.3)	74.5 (44.9-91.3)	4.1 (1.1-14.9)
Tonga	43.0 (38.5-47.7)	66.7 (57.8-74.5)	2.7 (1.8-4.0)	61.3 (34.8-82.4)	2.1 (0.7-6.4)	45.2 (41.3-49.2)	66.9 (58.5-74.3)	2.5 (1.7-3.6)	70.3 (44.3-87.5)	3.0 (1.1-8.6)
Vanuatu	56.1 (46.3-65.5)	69.1 (49.3-83.7)	2.2 (0.7-6.3)	34.9 (21.5-92.7)	0.7 (0.14-3.5)	41.2 (32.4-50.5)	54.7 (34.3-73.6)	1.8 (0.8-4.1)	71.1 (14.4-97.3)	3.4 (0.3-39.8)
Vietnam	20.2 (17.3-23.3)	30.9 (25.2-37.3)	2.4 (1.8-3.3)	37.0 (20.2-57.6)	4.3 (2.0-9.1)	8.4 (6.8-10.5)	15.9 (11.4-21.8)	2.3 (1.6-3.3)	28.3 (14.0-48.9)	5.1 (2.2-12.3)

[a] Fighting is defined as occurring when two students of about the same strength or power choose to fight each other

[b] Consumed at least one drink, but less than 4 drinks for females or less than 5 drinks for males on at least one occasion in the past 30 days

[c] Consumed at least 4 drinks for females or at least 5 drinks for males on at least one occasion in the past 30 days
[d] Rodrigues is an autonomous region within Mauritius
AMR = African Region, AMR = Region of the Americas, EMR = Eastern Mediterranean Region, WPR = West Pacific Region
AOR = Adjusted Odds Ratio (nondrinkers is the reference category)

Table 2.6. Prevalence and AORs of being seriously injured[a] in the past 12 months by alcohol consumption level

Country by WHO region (N)	Nondrinkers	Current Drinkers Who Did Not Binge[a]		Current Drinkers Who Binge[b]	
	% (95%CI)	% (95%CI)	AOR (95%CI)	% (95%CI)	AOR (95%CI)
AFR					
Ghana	69.2 (62.5-75.2)	86.7 (79.3-91.7)	2.9 (1.8-4.9)	–	–
Mauritius	35.2 (29.8-40.9)	48.7 (42.3-55.2)	1.6 (1.2-2.1)	57.1 (37.4-74.7)	2.0 (0.8-4.9)
Rodrigues[c]	42.9 (38.7-47.2)	54.5 (45.8-63.0)	1.6 (1.1-2.4)	79.5 (57.3-91.8)	5.1 (1.7-15.2)
Namibia	51.8 (48.2-55.3)	55.9 (50.8-60.9)	1.2 (1.0-1.5)	54.0 (42.2-65.4)	1.2 (0.8-1.7)
AMR					
Argentina	26.4 (24.6-28.3)	38.0 (35.5-40.6)	1.8 (1.5-2.0)	43.7 (40.1-47.5)	2.4 (2.0-2.8)
Belize	37.1 (33.7-40.7)	60.0 (53.1-66.6)	2.6 (1.9-3.5)	67.2 (54.1-78.1)	3.6 (2.0-6.4)
Bolivia	45.8 (43.5-48.1)	61.2 (56.1-66.1)	1.9 (1.5-2.5)	65.9 (55.7-74.9)	2.8 (1.7-4.7)
El Salvador	31.8 (27.8-36.2)	50.7 (41.2-60.1)	2.2 (1.3-3.6)	52.1 (38.6-65.2)	2.5 (1.5-4.4)
Guyana	31.4 (27.7-35.5)	42.7 (39.0-46.4)	1.7 (1.3-2.1)	49.2 (36.9-61.6)	2.2 (1.4-3.4)
Honduras	33.0 (30.9-35.2)	47.5 (39.6-55.6)	2.0 (1.4-2.8)	34.0 (24.4-45.1)	1.2 (0.8-1.9)
Jamaica	49.0 (37.9-60.3)	65.2 (57.0-72.6)	2.0 (1.4-2.9)	80.5 (70.6-87.6)	4.4 (2.1-9.3)
Peru	44.4 (40.7-48.1)	60.4 (54.8-65.8)	1.9 (1.5-2.5)	60.3 (50.5-69.2)	1.8 (1.2-2.7)
EMR					
Lebanon	34.5 (31.2-37.9)	48.3 (39.1-57.7)	1.7 (1.2-2.4)	69.3 (55.8-80.2)	4.1 (2.2-7.8)
Syria	43.4 (39.6-47.3)	65.3 (57.9-72.0)	2.2 (1.5-3.1)	63.4 (25.6-89.7)	2.4 (0.5-10.9)
WPR					
Cambodia	17.9 (15.4-20.8)	34.1 (26.3-42.9)	2.2 (1.5-3.3)	36.0 (23.3-51.0)	2.4 (1.2-4.5)
Fiji	48.3 (42.8-53.8)	63.5 (51.0-74.4)	1.7 (1.0-2.7)	76.4 (59.7-87.6)	3.0 (1.7-5.3)
Kiribati	54.1 (48.2-60.0)	62.8 (54.1-70.7)	1.3 (0.9-1.9)	65.2 (53.2-75.6)	1.6 (1.0-2.6)
Malaysia	33.4 (32.0-34.8)	46.1 (43.0-49.3)	1.6 (1.4-1.8)	52.9 (43.0-62.6)	2.1 (1.4-3.2)
Mongolia	34.4 (32.4-36.5)	53.8 (48.2-59.4)	2.3 (1.8-2.9)	61.6 (38.7-80.3)	3.4 (1.3-8.9)
Philippines	44.6 (41.0-48.2)	59.1 (51.8-66.1)	1.7 (1.3-2.2)	56.6 (47.3-65.5)	1.6 (1.1-2.4)
Samoa	74.0 (70.2-77.4)	95.9 (91.3-98.1)	7.8 (3.7-16.4)	96.7 (87.0-99.2)	10.5 (2.7-41.7)
Solomon Islands	63.4 (53.2-72.6)	85.7 (79.0-90.6)	3.5 (1.5-8.2)	90.5 (67.9-97.7)	5.5 (1.1-26.6)
Tonga	57.9 (54.3-61.5)	76.9 (70.7-82.3)	2.4 (1.7-3.5)	72.5 (53.0-86.0)	1.9 (0.8-4.6)
Vanuatu	61.6 (53.7-69.0)	69.7 (52.2-83.0)	1.3 (0.6-2.7)	65.4 (26.4-90.9)	1.1 (0.2-6.8)
Vietnam	25.7 (23.6-28.0)	39.8 (35.1-44.6)	1.9 (1.5-2.2)	37.2 (25.3-50.8)	1.8 (1.0-3.1)

[a] Defined as when it makes you miss at least one full day of usual activities (such as school, sports or a job) or requires treatment by a doctor or nurse

[b] Consumed at least one drink, but less than 4 drinks for females or less than 5 drinks for males on at least one occasion in the past 30 days

[c] Consumed at least 4 drinks for females or 5 drinks for males on at least one occasion in the past 30 days

[d] Rodrigues is an autonomous region within Mauritius

AMR = African Region, AMR = Region of the Americas, EMR = Eastern Mediterranean Region, WPR = West Pacific Region

AOR = Adjusted Odds Ratio (nondrinkers is the reference category)

Table 2.7. Prevalence and AORs of past year serious injury[a] by alcohol consumption level and sex

Country by WHO region	Male					Female				
	Non-drinkers	Current Drinkers Who Did Not Binge[a]		Current Drinkers Who Binge[b]		Non-drinkers	Current Drinkers Who Did Not Binge		Current Drinkers Who Binge	
	%, 95% CI	%, 95% CI	AOR (95%CI)	%, 95% CI	AOR (95%CI)	%, 95% CI	%, 95% CI	AOR (95%CI)	%, 95% CI	AOR (95%CI)
AFR										
Ghana	68.9 (61.7-75.3)	83.4 (78.8-87.2)	2.3 (1.5-3.5)	-	-	69.9 (63.4-75.6)	91.0 (75.7-97.0)	4.5 (1.5-13.2)	-	-
Mauritius	44.1 (39.6-48.7)	54.2 (47.0-61.3)	1.4 (1.1-1.0)	67.4 (45.1-83.9)	2.4 (0.7-7.4)	27.5 (23.5-31.9)	42.6 (33.6-52.2)	1.8 (1.2-2.8)	41.4 (17.7-70.0)	1.6 (0.4-5.5)
Rodrigues[c]	47.8 (42.6-53.0)	57.7 (45.7-69.0)	1.5 (0.9-2.4)	90.8 (66.9-98.0)	10.0 (1.8-56.8)	38.8 (33.0-44.9)	52.1 (42.0-62.0)	1.8 (1.1-2.8)	67.8 (31.8-90.4)	3.5 (0.8-15.9)
Namibia	58.2 (54.8-61.5)	60.6 (54.4-66.4)	1.2 (1.0-1.5)	60.8 (49.5-71.0)	1.3 (0.8-2.0)	47.5 (42.7-52.3)	50.3 (44.9-55.7)	1.2 (1.0-1.5)	47.5 (32.8-62.7)	1.1 (0.6-1.9)
AMR										
Argentina	34.0 (31.4-36.7)	46.9 (43.0-50.9)	1.9 (1.6-2.3)	55.6 (50.4-60.6)	2.7 (2.1-3.5)	19.6 (17.6-21.8)	29.0 (26.2-32.0)	1.6 (1.4-1.9)	33.3 (30.3-36.3)	2.0 (1.7-2.4)
Belize	41.5 (36.3-46.9)	64.8 (59.9-69.5)	2.8 (2.0-4.0)	76.3 (56.4-88.8)	4.8 (1.8-13.0)	33.9 (29.8-38.2)	54.8 (44.5-64.7)	2.4 (1.5-3.7)	58.5 (44.8-71.0)	2.9 (1.7-4.9)
Bolivia	51.9 (48.7-55.0)	65.0 (58.6-70.8)	1.9 (1.4-2.6)	62.6 (47.1-75.8)	2.0 (1.0-3.7)	39.2 (35.5-42.9)	55.5 (46.6-64.0)	1.9 (1.2-2.9)	74.2 (62.8-83.0)	5.8 (2.9-11.8)
El Salvador	39.2 (34.6-44.0)	48.6 (39.3-58.0)	1.5 (0.9-2.5)	53.0 (32.3-72.7)	1.7 (0.6-4.3)	24.1 (19.5-29.4)	53.8 (36.7-70.1)	3.9 (1.8-8.7)	51.4 (36.7-65.9)	3.5 (1.9-6.5)
Guyana	34.4 (26.3-32.1)	46.9 (41.7-52.1)	1.7 (1.2-2.5)	48.9 (34.8-63.2)	2.0 (1.1-3.6)	29.8 (26.2-33.7)	37.4 (31.5-43.8)	1.5 (1.1-1.9)	48.8 (33.7-64.1)	2.2 (1.2-4.1)
Honduras	41.0 (36.0-46.2)	52.8 (37.1-68.0)	1.7 (0.9-3.2)	34.4 (17.4-56.6)	0.8 (0.3-2.0)	26.2 (22.0-30.8)	43.6 (31.9-56.0)	2.3 (1.4-3.6)	37.6 (23.8-53.8)	1.8 (0.9-3.7)
Jamaica	56.8 (42.7-69.9)	64.7 (52.8-75.0)	1.4 (1.1-2.0)	85.0 (70.8-92.9)	4.3 (1.4-13.2)	41.4 (31.2-42.4)	65.9 (56.8-74.0)	2.8 (1.7-4.6)	74.0 (52.3-88.1)	4.3 (1.5-12.0)
Peru	49.1 (43.4-54.8)	65.1 (57.8-71.7)	2.0 (1.4-2.9)	68.5 (56.2-78.7)	2.3 (1.2-4.1)	39.9 (36.0-43.9)	54.9 (48.3-61.3)	1.8 (1.4-2.5)	48.6 (32.4-65.2)	1.4 (0.7-2.8)
EMR										
Lebanon	38.1 (33.0-43.5)	50.4 (39.9-60.8)	1.6 (1.1-2.5)	70.6 (52.2-84.0)	4.0 (1.8-9.3)	32.2 (29.1-35.4)	45.4 (36.3-54.9)	1.8 (1.2-2.7)	53.6 (25.2-79.8)	2.5 (0.7-8.7)
Syria	48.6 (43.7-53.6)	68.5 (59.3-76.4)	2.3 (1.4-3.5)	-	-	38.3 (34.1-42.8)	54.0 (45.1-62.7)	1.9 (1.3-2.7)	-	-

Table 2.7 (continued)

WPR										
Cambodia	20.2 (16.8-24.0)	33.5 (26.1-41.8)	2.0 (1.4-2.8)	33.3 (20.7-48.9)	2.0 (1.0-3.7)	16.0 (12.7-20.0)	36.1 (18.5-58.5)	3.0 (1.1-7.7)	52.6 (28.5-75.6)	6.5 (2.2-19.0)
Fiji	55.5 (44.7-65.8)	68.5 (56.2-78.7)	1.7 (0.8-3.6)	74.8 (51.7-89.2)	2.5 (1.3-5.0)	41.8 (36.0-47.8)	54.4 (35.1-72.4)	1.6 (0.8-3.4)	80.9 (57.6-92.9)	5.3 (1.5-18.7)
Kiribati	59.2 (51.3-66.6)	62.6 (52.4-71.7)	1.2 (0.7-2.0)	72.0 (56.7-83.4)	2.0 (1.1-3.5)	51.1 (45.3-56.9)	63.1 (53.0-72.1)	1.6 (1.1-2.3)	52.6 (39.5-65.4)	1.1 (0.6-2.1)
Malaysia	40.5 (38.9-42.0)	51.3 (46.5-56.0)	1.6 (1.3-1.9)	53.2 (41.2-64.8)	1.8 (1.1-2.9)	26.9 (25.3-28.5)	37.7 (33.6-41.9)	1.6 (1.3-2.0)	54.3 (37.2-70.5)	3.3 (1.6-6.6)
Mongolia	39.9 (36.9-42.9)	59.4 (53.0-65.4)	2.4 (1.8-3.2)	73.2 (35.5-93.1)	4.1 (0.8-21.0)	29.6 (27.3-32.0)	45.2 (35.7-55.1)	2.2 (1.5-3.3)	51.8 (22.7-79.7)	2.9 (0.8-11.0)
Philippines	50.1 (45.1-55.2)	63.5 (54.4-71.8)	1.7 (1.2-2.5)	62.6 (52.0-72.0)	1.7 (1.0-2.7)	40.1 (36.0-44.3)	51.3 (43.8-58.9)	1.6 (1.1-2.1)	50.4 (39.5-61.3)	1.5 (1.0-2.4)
Samoa	79.7 (75.2-83.5)	97.2 (93.6-98.8)	9.8 (4.3-22.2)	91.3 (65.7-98.3)	2.4 (0.4-13.4)	70.3 (65.9-74.4)	93.7 (85.9-97.3)	6.1 (2.7-14.0)	-	-
Solomon Islands	63.2 (49.0-75.5)	85.0 (77.1-90.5)	3.2 (1.1-9.2)	90.8 (65.4-98.1)	5.3 (0.9-30.9)	63.1 (54.3-71.1)	87.5 (78.1-93.2)	4.5 (2.3-8.7)	90.9 (57.0-98.7)	6 (0.8-44.5)
Tonga	53.3 (47.7-58.8)	83.2 (75.8-88.7)	4.5 (2.7-7.2)	79.5 (47.5-94.4)	3.6 (0.8-16.1)	63.3 (59.1-67.3)	70.9 (60.8-79.2)	1.3 (0.8-2.2)	66.2 (40.8-84.8)	1.0 (0.4-3.0)
Vanuatu	67.9 (60.0-74.9)	72.1 (58.2-82.7)	1.3 (0.7-2.5)	43.1 (10.7-82.7)	0.4 (0.1-2.8)	55.5 (44.7-65.7)	65.5 (34.0-87.5)	1.4 (0.4-4.5)	-	-
Vietnam	30.9 (28.3-33.7)	40.6 (34.1-47.6)	1.7 (1.3-2.2)	49.2 (34.6-64.1)	2.7 (1.4-5.2)	22.1 (19.8-24.6)	38.4 (31.3-46.1)	2.2 (1.6-3.0)	17.7 (8.1-34.3)	0.8 (0.3-1.7)

[a] Defined as when it makes you miss at least one full day of usual activities (such as school, sports or a job) or requires treatment by a doctor or nurse
[b] Consumed at least one drink, but less than 4 drinks for females or less than 5 drinks for males on at least one occasion in the past 30 days
[c] Consumed at least 4 drinks for females or at least 5 drinks for males on at least one occasion in the past 30 days
[d] Rodrigues is an autonomous region within Mauritius
AMR = African Region, AMR = Region of the Americas, EMR = Eastern Mediterranean Region, WPR = West Pacific Region
AOR = Adjusted Odds Ratio (nondrinkers is the reference category)

PAPER 3

Are alcohol policies correlated with prevalence of youth alcohol consumption in 18 low- and middle-income countries?

ABSTRACT

Introduction

Consumption of alcohol by adolescents is of global concern due to the potentially harmful short- and long-term effects of its use on both individuals and society. Alcohol control policies are effective in reducing alcohol-related harm, but little is known about youth outcomes in low- and middle-income countries (LMICs). The purpose of this study was to determine if certain alcohol policies were correlated with alcohol consumption patterns by youth in LMICs.

Methods

Data was obtained from the World Health Organization's Global School-based Student Health Survey (GSHS), designed to measure and assess the behavioral risk and protective factors covering the leading causes of morbidity and mortality among 13-17 year-old students, primarily in LMIC settings. Policy data was obtained from the Global Information System on Alcohol and Health.

Results

More restrictive policies, such as a minimum legal purchase age of 20 or 21 years of age and the presence of sobriety checkpoints, were inversely correlated with prevalence of current and binge drinking among youth, even after adjusting for age, sex, and country-level income.

Discussion

Stricter alcohol policies are correlated with lower consumption among youth in LMICs as in high-income countries. Further research should include information on enforcement and additional individual demographic data. Additionally, longitudinal surveys of youth alcohol use and policy changes in LMIC countries would greatly increase the ability to assess causality.

INTRODUCTION

Consumption of alcohol by adolescents is of global concern due to the potential short- and long-term effects of its use on both individuals and society. Alcohol use is the primary risk factor globally for death and disability among youth ages 15-24 years[143] and is associated with impaired neurological development, sexually transmitted diseases, motor vehicle crashes, homicide, and suicide, among other harms.[155-158] Alcohol consumption and related harms vary widely across and even within countries, due to a combination of cultural influences (e.g., historical experience of alcohol in the society), economic and demographic factors (e.g., level of country development), and the policy environment.[72,75] Alcohol policies influence the relationships between alcohol, health, and society through regulatory measures to reduce risky drinking, and through enforcement of those measures.[75,159]

While effective alcohol control is not based on a single policy, but rather a combination of policies and regulations coupled with appropriate levels of enforcement,[75] most research has evaluated discrete policies in predominantly European or Organization for Economic Co-operation and Development (OECD) countries. The World Health Organization (WHO), in its first Global Strategy to Reduce the Harmful Use of Alcohol (the "Global Alcohol Strategy"), the U.S. Centers for Disease Control and Prevention (CDC), and other major public health bodies have identified a range of interventions that are most effective in reducing alcohol-related harm. These include regulating the physical availability of alcohol, drinking-driving prevention and countermeasures, advertising restrictions, and pricing and taxation.[94,160-162] Policy recommendations are predominantly geared toward overall population-level effects; however, an effective strategy must take special populations (e.g., youth) or locations (e.g., low and middle-income countries) into consideration. Many policies that are the most effective for reducing

excessive drinking in adults are similarly effective for youth; however, this is not always the case.[163] Effectiveness may be inappropriately inferred from population studies or there may be independent effects making the policy more or less effective for a youth population.[159]

There have been attempts to evaluate the policy environment overall through creation of a scale or index for use in evaluation of the effectiveness of policy changes over time and for cross-national comparisons.[12,69,164,165] A number of these composite measures have been used to simply quantify the strictness of the policy environment and identify domains that are weaker or stronger,[166,167] while others have been used in regression analyses, finding correlations between the index score and levels of adult per capita consumption (APC) or other outcomes.[118,119,121] In 2007, Brand et al. developed an Alcohol Policy Index (API) that included 16 policies under five WHO-recommended domains (the above plus drinking context): a stricter score was inversely correlated with APC in the 30 OECD member countries.[118] More recently, Naimi et al. created an Alcohol Policy Scale (APS) that found strong inverse associations between a stricter score and adult binge drinking prevalence and homicide in the US.[119,168]

The preponderance of evidence on alcohol policies comes from high-income countries (HICs),[111,120,167,168] leading to a paucity of research from low- and middle-income countries (LMICs). A small but growing body of literature is emerging from LMICs, such as evaluations of drinking- driving policies in single LMICs.[104,169] Only two studies have evaluated multiple policies in LMICs cross-nationally.[122,123] Cook et al. found significant associations consistent with research from HICs between individual policies under four of five domains: physical availability, age eligibility of purchase, pricing, and advertising (no significant associations were found with the motor vehicle-related policies); and five alcohol consumption measures in adults (18-65 years) in 15 LMICs.[122] Individual policies were evaluated due to the small number of

countries. In a study of 46 African countries using a modified API, Ferreira-Borges et al. found stricter country-level policy scores to be negatively associated with APC in adults (15 years and older).[123]

Several recent studies have evaluated alcohol policies and youth outcomes, but only in HICs. Using Brand et al.'s API, Gilligan et al. and Paschall et al. found that a higher API score was inversely associated with weekly drinking among 15-16 year old youth in HICs.[107,108] We are not aware of any studies evaluating correlations between alcohol policies and alcohol consumption among youth across multiple LMICs. We hypothesize that stricter alcohol policies will be correlated with lower prevalence of alcohol consumption among youth across countries after adjusting for a number of individual- and country-level factors. These relationships were explored in 18 LMICs, making novel use of youth survey data from the alcohol module in the WHO's Global School-based Student Health Survey (GSHS) and policy information collected for the WHO's Global Status Report on Alcohol and Health.[3]

METHODS

Data sources

The Global Information System on Alcohol and Health has been a part of the WHO's Global Health Observatory data repository since 1997. It forms the basis for the WHO's periodic global status reports on alcohol, and contains a wide range of alcohol-related health indicators under eight categories: levels of consumption; patterns of consumption; harms and consequences; economic aspects; alcohol control policies; prevention, research, and treatment; youth and alcohol; and key alcohol indicators relevant to non-communicable diseases. The alcohol control policies category is primarily informed by the WHO Global Survey on Alcohol and Health (GSAH). The GSAH is sent to country contacts roughly every three years; policy

information is based on what is currently enacted; no implementation dates are provided. The most recent available data came from the 2012 iteration. Four alcohol control policies under three domains will be evaluated: (1) physical availability: minimum purchase age and drinking in public, (2) advertising: advertising restrictiveness, and (3) drinking-driving: use of sobriety checkpoints.

The GSHS was developed by the WHO in collaboration with United Nations' UNICEF, UNESCO, and UNAIDS, and with technical assistance from the Centers for Disease Control and Prevention (CDC). It was designed to measure and assess the behavioral risk and protective factors in 10 key areas that cover the leading causes of morbidity and mortality worldwide among 13-17 year-old students, primarily in LMIC settings: alcohol use, dietary behaviors, drug use, hygiene, mental health, physical activity, protective factors, sexual behaviors, tobacco use, and violence/unintentional injury. It is implemented at a country level, uses a standardized cluster sample selection process to collect age, sex, and country-specific grade levels, and is designed to be self-completed by students with pen and paper in one class period. The first stage of the two-stage sampling design uses a probability proportionate to size method to select schools from a list of all schools. The second stage targets classrooms in the schools with students of the target age groups; all students within the chosen class are eligible to participate. Completed data sheets are sent to CDC for processing and editing of data; the same edits are used in all countries to ensure comparability across countries. Data files are made public two years after a country approves the final report, and contain de-identified information. Final data files contain weighted data, allowing results to be nationally representative. Between 2003 and 2015, at least 94 countries completed a GSHS (450,000 students).[132] The GSHS provided individual level alcohol consumption data, sex, and age of student respondents.

Study population

A time period of 2010-2015 was chosen as the study period, as older data may not be as relevant due to changes in population demographics, national income or other unknown factors. Sixty-four countries and one autonomous region posted public data from the GSHS between 2010-2015, but not all completed the alcohol module. A consideration for this analysis is the timing of the policy collection and the survey collection. Both the policy database and the survey datasets are cross-sectional, and often there is little control, if any, of timing of exposure and outcome measures in cross-sectional research. The policy database was updated in 2008 and 2012, however, so only GSHS survey data collected after the policy database update was used. Nine countries were missing policy data completely or were missing data prior to the GSHS year and were excluded. Four countries (three in the Region of the Americas [AMR] and one in the Western Pacific Region [WPR]) were classified by the World Bank classification as high-income and were excluded. Thus, datasets from 2010-2015 for 18 countries were included in the analyses for this paper (Table 3.1). Sample sizes varied from 1,582 (Kiribati) to 28,368 (Argentina), with a median of 3,216.

Measures

Physical availability restrictions

Minimum legal purchase age (MLPA) was measured on three levels: none, 16-19 years, and 20 years or older (Table 3.2).

The drinking in public variable contained nine sub-categories (educational buildings, government offices, healthcare establishments, leisure events, parks and streets, public transport, places of worship, sporting events, workplaces) with categorical responses of no restrictions, partial restriction, ban, and voluntary/self-restricted. This measure evaluated the five locations

most relevant to youth consumption: educational buildings, leisure events, parks and streets, public transport, sporting events). The measure was coded as 2 for ban, 1 for partial restrictions, and 0 for no restrictions or voluntary/self-restrictions for each of the locations and then summed for a single restrictiveness score.

Advertising restrictions

The alcohol marketing restrictiveness scale developed by Esser and Jernigan was used as a model to evaluate this measure.[170] This scale includes level of national alcohol advertising restrictions on three alcoholic beverage types (beer, wine, and spirits) across ten media types (national TV, private TV, national radio, local radio, print, billboards, point of sale, cinema, internet, social media). Their score was based on a 2-1-0 point system, with 2 points for total restriction, 1 point for partial, and 0 points for either self-regulation/voluntary restrictions or no restrictions, resulting in a 5-point scale (1-least restrictive, 2-slightly restrictive, 3-restrictive, 4-very restrictive, 5-most restrictive). Due to the small number of countries, this variable was dichotomized into more restrictive (4-5) versus less restrictive (1-3).

Drink-driving interventions

Sobriety checkpoints were dichotomized as Yes/No for their presence or absence.

Alcohol consumption

Current drinking, one of the outcome variables, was assessed in the GSHS by the number of days the students reported having at least one full drink in the past 30 days on a seven-point scale ranging from 0 times to all 30 days. Responses were dichotomized to reflect none vs one or more days. Binge drinking was assessed by the usual number of drinks students reported having when they drank in the past 30 days on a six-point scale ranging from I did not drink to 5 or more. A response of 5 or more defined binge drinking for males, while responses of 4 or more

defined binge drinking for females. Results were dichotomized as binge vs. consumption less than binge (including no reported consumption).

Data Analysis

Logistic regression was used to analyze the bivariate correlations between each policy, student and country indicators, and the two alcohol use outcome variables (current drinking, binge drinking). Multivariate logistic regression was used to analyze correlations between the outcome variables and each policy, adjusting for sex and age (Model 1) and sex, age, and World Bank income classification as of survey year (Model 2).

RESULTS

Data from the GSHS represented 108,064 respondents from 18 countries. Bivariate analyses between policies, sex, age, national income, and WHO region are presented in Table 3.3. Male students reported a greater prevalence of current drinking of 27.6% versus females (23.0%), but reported a 0.8 lower OR of binge drinking (95%CI: 0.7-0.8). Older students reported more current and binge drinking than younger ones. Current and binge drinking were more prevalent in upper-middle income countries than those classified as low and low-middle income. The greatest prevalence of current and binge drinking by WHO region was in countries in the Americas region (AMR - current: 44.9%, binge: 16.1%) followed by the AFR, the WPR, and the Eastern Mediterranean Region (EMR).

For each of the four policies, students in countries with the most restrictive policy reported the lowest prevalence of current and binge drinking. Countries with an MLPA of 16-19 years had a 3.5 greater odds ratio (OR) of current drinking (95%CI: 3.3-3.7) as compared with countries with an MLPA of 20 years or older. A less restrictive drinking in public score was associated with a greater OR of current drinking (2.4, 95%CI: 2.3-2.5) and binge drinking (5.3,

95%CI: 4.8-5.9) among youth. Young people in countries that reported conducting sobriety checkpoints had 0.5 (95%CI: 0.5-0.5) and 0.2 (95%CI: 0.2-0.2) lower odds of current and binge drinking, respectively.

Greater AORs were found in the more restrictive policy categories and the current drinking outcome in Model 1 in the multivariate analysis (sex and age), although the AORs were not significantly different than ORs from the bivariate analysis (Table 3.4). In Model 2 (sex, age, World Bank income classification), AORs for current drinking and an MLPA of 16-19 years (2.4, 95%CI: 2.3-2.6) or none (1.3, 95%CI: 1.2-1.4), less restrictive drinking in public score, (1.5, 95%CI: 1.4-1.6) and less restrictive advertising score (3.0, 95%CI: 2.8-3.2) remained greater than the reference levels, although significantly reduced. The AOR of presence of sobriety checkpoints and current drinking declined significantly from 0.5 to 0.3.

The AORs in Model 1 for the binge drinking outcome also were not significantly different from the ORs in the bivariate analysis. Adjusted odds ratios for binge drinking and an MLPA of 16-19 years (2.0, 95%CI: 1.7-2.3), less restrictive drinking in public score (3.0, 95%CI: 2.7-3.4), and less restrictive advertising score (4.6, 95%CI: 3.8-5.6) were significantly greater than the reference categories, although again reduced from the ORs in the bivariate analysis. The AOR for binge drinking and no reported MLPA was greater compared to 20+ years (1.6, 95%CI: 1.4-1.9), but not statistically different than the bivariate OR. The AOR for binge drinking and use of sobriety checkpoints increased significantly from an OR of 0.2 (95%CI: 0.2-0.2) to 0.5 (95%CI: 0.4-0.5).

DISCUSSION

Our findings in this study of LMICs are predominantly consistent with findings on alcohol policies in HICs. More restrictive policies, such as a minimum legal purchase age of 20

or 21 years of age and the presence of sobriety checkpoints, were inversely correlated with prevalence of current and binge drinking among youth. Policies remained significantly correlated with drinking outcomes after adjustments for sex and age and with further adjustment with country-level income. The greatest AORs for current and binge drinking in the fully adjusted model were for the more restrictive advertising score.

Of the four policies evaluated, advertising restrictiveness is an area where LMICs could see great gains. Youth exposure to alcohol advertising has been shown to be associated with an increase in drinking in youth already drinking or an increased risk of initiating alcohol use,[94] an association that is also seen in LMICs.[100,171] Systematic reviews indicate that industry self-regulation of advertising content is poor, and violations are common[95]; however, the industry specifically uses the argument of the effectiveness of their self-regulation against any type of marketing restrictions.[172] Low- and middle-income countries may be in a better position to greatly restrict or even ban alcohol marketing in ways that the U.S. historically cannot or, in the lowest income countries, before the global alcohol industry begins significant investment and expansion with growing national income.

Although the MLPA results were in the hypothesized direction, they were not completely in line with predictions, and the decline in the AORs with the inclusion of country-level income requires further investigation. First, an MLPA of 16-19 years was correlated with significantly greater odds of both current and binge drinking than no reported legal age in bivariate and multivariate analyses. This could be a result of differing levels of enforcement of MLPA policies or a reflection of varying degrees of cultural acceptance of alcohol use, both of which were not assessed in this study. Most of the AORs in both the current and binge drinking models that included World Bank classification declined (Model 2); it is possible that less-resourced

countries with lower levels of consumption in general may be more likely to adopt stricter policies.[122] It has also been suggested that the greater prevalence of informal alcohol markets in many LMICs may impede effectiveness of policies to regulate pricing or availability.[173]

There are a number of limitations to this study. First, data in the GSHS were self-reported, and students may have under- or over-reported their alcohol consumption. Alcohol consumption has been found to be under-reported compared to national sales data[19]; if students were to consistently under-report, the size of the correlations in our analysis could be more conservative (i.e. smaller) than the actual relationships. Second, the income variable is at the country level, not the individual level, and may not reflect the situation of the individual student. Third, the effectiveness of a policy is related to its enforcement, which has not been analyzed in this study. Fourth, our selection of countries is small, with no representation from the Southeast Asia region and only one country from EMR, so caution is necessary in drawing conclusions beyond the study countries themselves; collinearity stemming from small sample size precluded the analysis of additional youth-oriented policies (such as blood alcohol concentration). Finally, as this is a cross-sectional study, causality cannot be ascertained. While efforts were made to obtain policy measures prior to survey measures, it is possible that countries that already have lower alcohol consumption prevalence will enact more restrictive policies as it may be easier or more acceptable to do so when lower alcohol consumption is more normative.

In the introduction of the Global Alcohol Strategy, then-Assistant Director-General for Noncommunicable Diseases and Mental Health Dr. Ala Alwan framed the harmful use of alcohol as a development issue, stating that developing countries shoulder a greater burden of morbidity and mortality.[12] This new resource aimed to improve "health and social outcomes for individuals, families, and communities"[12(p8)] by providing general guidance, setting global

priorities, and recommending policy interventions. Despite this and other calls to action on research specific in LMICs,[174] there remains very limited information on which policies are the most effective in the LMIC setting and virtually none for youth in these settings. Analyses using the GSHS are limited to correlations rather than methods that can detect causation; only a handful of countries out of 94 have fielded the GSHS more than once, barring the use of methods such as difference-in-differences or pre/post-test. Additionally, the policies available in GISAH do not provide information on implementation dates, which could be used to measure duration of exposure required for time-series analyses.

Despite these limitations, the inverse correlations between the study policies and current and binge drinking prevalence among youth in these 18 LMICs support the hypothesis that stricter alcohol policies are correlated with lower consumption among youth in LMICs as in HICs. Further research should include information on enforcement and additional individual demographic data. Additionally, longitudinal surveys of youth and alcohol use in LMIC countries would greatly increase the ability to track trends as alcohol policies are strengthened or weakened and to use causal methods to determine which are the most effective in the LMIC setting.

Table 3.1. Characteristics of GSHS participants, countries

Country by WHO region	Survey Year	Survey Respondents	World Bank Classification
AFR			
Ghana	2012	3,633	LM
Mauritius	2011	2,168	L
Namibia	2013	4,531	UM
AMR			
Argentina	2012	28,368	UM
Bolivia	2012	3,696	LM
El Salvador	2013	1,915	LM
Guyana	2010	2,392	LM
Honduras	2012	1,779	LM
Jamaica	2010	1,623	UM
Peru	2010	2,882	UM
EMR			
Syria	2010	3,102	LM
WPR			
Cambodia	2013	3,806	L
Fiji	2010	1,673	LM
Kiribati	2011	1,582	LM
Malaysia	2012	25,507	UM
Mongolia	2013	5,393	LM
Philippines	2011	5,290	LM
Vietnam	2013	3,331	LM

AFR = Africa region, AMR = Region of the Americas, EMR = Eastern Mediterranean region, WPR = Western Pacific region
L = Low, LM = Low-middle, UM = Upper-middle

Table 3.2. Number of respondents and countries by policy

Country alcohol policies	Total n (%)	Countries
Physical availability		
Miminum legal purchase age		
≥20	12,368 (12.0)	Kiribati, Mongolia,
18-19	77,394 (74.9)	Argentina, El Salvador, Honduras, Jamaica, Malaysia, Mauritius, Namibia, Peru, Philippines, Vietnam
16-17	2,392 (2.3)	Guyana
None	11,135 (10.8)	Bolivia, Cambodia, Ghana,
Drinking in public		
More restrictive	22,269 (20.6)	Mauritius, Mongolia, Peru, Syria, Vietnam
Less restrictive	85,795 (79.4)	Argentina, Bolivia, Cambodia, El Salvador, Fiji, Ghana, Guyana, Honduras, Jamaica, Kiribati, Malaysia, Namibia, Philippines
Promotion		
Advertising restrictiveness		
More restrictive	13,888 (13.3)	Mongolia, Syria
Less restrictive	90,229 (86.7)	Argentina, Bolivia, Cambodia, El Salvador, Fiji, Ghana, Guyana, Jamaica, Kiribati, Malaysia, Namibia, Peru, Philippines, Vietnam
Drink driving		
Sobriety checkpoints, presence	45,689 (42.3)	Fiji, Guyana, Jamaica, Kiribati, Malaysia, Mauritius, Namibia, Peru, Vietnam

Table 3.3. Bivariate correlations between policies, demographics, country characteristics, current drinking, and binge drinking

Variables	Current drinking		Binge drinking	
	%	OR (95%CI)	%	OR (95%CI)
Minimum legal purchase age				
20+	11.0	1.0	2.2	1.0
16-19	30.0	3.5 (3.3-3.7)	9.4	4.5 (4.0-5.1)
None	14.4	1.4 (1.3-1.5)	3.7	1.7 (1.5-2.0)
Drinking in public				
Most restrictive	14.2	1.0	1.8	1.0
Least restrictive	28.2	2.4 (2.3-2.5)	9.1	5.3 (4.8-5.9)
Advertising score				
More restrictive	7.7	1.0	0.9	1.0
Less restrictive	28.3	4.8 (4.5-5.1)	8.8	10.5 (8.8-12.5)
Sobriety checkpoints	17.7	0.5 (0.5-0.5)	2.6	0.2 (0.2-0.2)
Sex				
Female	23.0	1.0	6.6	1.0
Male	27.6	1.3 (1.2-1.3)	8.5	0.8 (0.7-0.8)
Age				
<=13 years	15.0	1.0	3.9	1.0
14 years	24.7	1.9 (1.8-2.0)	7.5	2.0 (1.8-2.2)
15 years	30.0	2.4 (2.3-2.6)	9.5	2.6 (2.4-2.8)
16 years or older	29.5	2.4 (2.3-2.5)	8.9	2.4 (2.2-2.6)
National income				
Low	15.7	1.0	3.8	1.0
Low-middle	16.4	1.0 (1.0-1.1)	3.2	0.8 (0.7-1.0)
Upper-middle	31.8	2.5 (2.3-2.7)	10.7	3.0 (2.6-3.5)
WHO region				
EMR	6.3	1.0	0.3	1.0
WPR	11.1	1.9 (1.6-2.2)	2.0	7.9 (3.9-15.9)
AFR	24.4	4.8 (4.2-5.6)	3.7	15.0 (7.5-30.3)
AMR	44.9	12.2 (10.6-14.2)	16.1	73.9 (36.9-148.1)

[a] Defined as at least 1 full drink in the past 30 days
[b] Defined as 4 or more drinks for females and 5 or more for males on at least one occasion in the past 30 days
AMR = Region of the Americas, AFR = Africa region, WPR = Western Pacific region, EMR = Eastern Mediterranean region

Table 3.4. Multivariate correlations between country-level alcohol policies and current[a] and binge[b] drinking

Policies	Current drinking			Binge drinking		
	Bivariate	Model 1	Model 2	Bivariate	Model 1	Model 2
	OR (95%CI)	AOR (95%CI)		OR (95%CI)	AOR (95%CI)	
Minimum legal purchase age						
20+	1.0	1.0	1.0	1.0	1.0	1.0
16-19	3.5 (3.3-3.7)	3.3 (3.1-3.5)	2.4 (2.3-2.6)	4.5 (4.0-5.1)	4.3 (3.8-4.9)	2.0 (1.7-2.3)
None	1.4 (1.3-1.5)	1.2 (1.1-1.3)	1.3 (1.2-1.4)	1.7 (1.5-2.0)	1.6 (1.3-1.8)	1.6 (1.4-1.9)
Drinking in public						
More restrictive	1.0	1.0	1.0	1.0	1.0	1.0
Less restrictive	2.4 (2.3-2.5)	2.3 (2.2-2.3)	1.5 (1.4-1.6)	5.3 (4.8-5.9)	5.2 (4.7-5.7)	3.0 (2.7-3.4)
Advertising score						
More restrictive	1.0	1.0	1.0	1.0	1.0	1.0
Less restrictive	4.8 (4.5-5.1)	4.4 (4.1-4.7)	3.0 (2.8-3.2)	10.5 (8.8-12.5)	9.6 (8.0-11.4)	4.6 (3.8-5.6)
Sobriety checkpoints, presence	0.5 (0.5-0.5)	0.4 (0.4-0.5)	0.3 (0.3-0.3)	0.2 (0.2-0.2)	0.2 (0.2-0.2)	0.5 (0.4-0.5)

[a] Current drinking is defined as drinking one or more alcoholic drinks in the past 30 days
[b] Binge drinking is defined as drinking 4 or more alcoholic drinks for females and 5 or more drinks for males on at least one occasion in the past 30 days
Model 1 included individual student characteristics (sex, age)
Model 2 included World Bank classification of country
OR = odds ratio, AOR = adjusted odds ratio, CI = confidence interval

SUMMARY

For at least the past 40 years, the World Health Organization (WHO) has promoted attention to alcohol use and policy development in the public health perspective. In 1975, with the publication of *Alcohol Policies in Public Health Perspective*, Bruun et al. stated definitively that "…changes in the overall consumption of alcoholic beverages have a bearing on the health of the people in any society."[58(pp12-13)] A number of resolutions and alcohol-focused publications emerged from the WHO in the ensuing years, along with a number of political setbacks in advancing the issue. In 1999, however, the WHO published the first Global Status Report on Alcohol, calling it "the formal beginning of WHO's new Global Alcohol Initiative, which is a comprehensive effort to conduct and synthesize research, distil information based on the best available evidence, and to provide technical assistance and policy guidance to Member States."[65(p.xi)] The global strategy to reduce the harmful use of alcohol was adopted by the World Health Assembly (WHA) in 2010, calling alcohol use more than just a public health issue, but a development issue.[12] Beyond the recognition of alcohol's influence on social problems such as crime, the WHO has attempted to make alcohol additionally cross-cutting by including a 10 percent reduction in the harmful use of alcohol by 2025[2] as one of the nine global goals for non-communicable disease (NCD) control.

A global strategy on alcohol recognizes that there are best practices on prevention and points of intervention at a high level, which must be customized based on available data, cultural influences, and other country-specific parameters. The literature on the epidemiology, economics, and policy interventions for reducing the harms stemming from alcohol use is extensive in European countries (primarily the Scandinavian countries and western Europe) and

[2] http://www.who.int/nmh/global_monitoring_framework/gmf1_large.jpg

North America, with a growing body of evidence from Latin America, Eastern Europe, and the BRICS (Brazil, Russia, India, China, and South Africa).

Alcohol is a causal or contributing factor in more than 200 diseases and injury conditions such as cirrhosis of the liver, poisonings, and road traffic crashes.[4] Globally, alcohol consumption is in the top seven leading risk factors for disease burden,[2] but a more important story emerges when we look more closely. Young people ages 10-24 years have a higher burden of alcohol-caused disability-adjusted life years (DALYs) than other age groups, and as of 2010, alcohol was the leading cause of death and disability for males ages 15-24 years in every WHO region except the Eastern Mediterranean (EMR). It was also the leading cause of death and disability for females in this age group in high-income countries (HICs) and the Region of the Americas (AMR).[11] Despite this significant burden for young people and the observation that as development increases, so does alcohol-related harm, very few resources are available from international agencies specifically targeting alcohol.[175] This is in comparison to a global alcoholic beverages market valued at $1.3 trillion in 2015, with a projection to reach almost $1.6 trillion by 2022.[3]

This project was initially inspired by my time living in Papua New Guinea (PNG) in 2012-2013, one of the least developed countries in the world and the largest island in the South Pacific. I experienced firsthand the Australian heavy drinking culture, fueled by the extraordinary amount of money being paid to ex-patriots in the mining industries working in country. $100 boxes of cigars and $200 bottles of Scotch were frequently shared in this community, while the majority of Papua New Guineans were living in the most austere conditions imaginable. I also saw however, that a "locally brewed" beer, while owned by the

[3] https://www.prnewswire.com/news-releases/alcoholic-beverages-market-expected-to-reach-1594-billion-globally-by-2022---allied-market-research-618354513.html

Dutch company, Heineken, had joined the list of prized items included for "bride prices" in many tribes across the island. Traditionally comprising pigs, chickens, and the like, beer and Coca-Cola had taken on special significance. Within my first week there, I had already been invited onto one of the biggest radio shows to talk about alcohol-related harms, and had been invited to join the committee supported by the Ministry of Health which was developing a national alcohol policy. Soon thereafter, a special issue of the International Journal of Alcohol and Drug Research (IJADR), the official journal of the Kettil Bruun Society for Social and Epidemiological Research on Alcohol, featured a number of studies on alcohol policies in LMICs. The introduction highlighted the extensive evidence base that exists from HICs, and called for the WHO to increase resources for scholarly endeavors leading to publications on LMICs.[174] Together this experience followed by the call to action led me to the current project.

The first aim of this project was simply to quantify the prevalence of alcohol use in a number of LMICs using an alcohol-specific module from the WHO's Global School-based Student Health Survey (GSHS) and explore patterns based on sex, age, country-level income, and majority religion. While occasionally included as a covariate in a handful of other studies, no one had endeavored to use the GSHS data for more than a series of straightforward tables and graphs on factsheets. Other than a few country-specific youth focused surveys, little data exists on youth alcohol consumption in LMICs, and this dataset provided an opportunity to paint a picture of patterns of alcohol consumption across a number of LMICs specifically. Additionally, binge drinking is a pattern of consumption that is associated with greater harm than drinking at levels less than binge.[44,176] This has not been systematically studied in LMICs; by using the GSHS question on quantity, a binge variable was created.

Most of the findings from Aim 1 were not surprising. Alcohol consumption in youth increased with country-level income (as defined by the World Bank). Males consistently reported a greater prevalence of current consumption than females. Countries with Islam and Hinduism as the majority religion had the lowest prevalence rates both overall and among males and females. A surprising finding, however, was that females in 13 of the 25 study locations reported a greater prevalence of binge drinking among current drinkers than males. Although none of the differences were statistically significant, a comment must be made on the actual structure of the binge drinking variable.

Binge drinking is defined as consuming 4 or more drinks for females or 5 or more for males on a single occasion or short period of time. A person may drink one drink every day for 29 days of the month, but if they reach the binge threshold on the 30th day, they are classified as having had a binge episode. There are a number of frequency thresholds in the literature used to measure the impact of binge drinking, but one of the most common is at least once in the past 30 days (usually defined as "current"). Many surveys ask a separate question to assess binge drinking such as in the Youth Behavior Risk Surveillance Survey (YRBS): "During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?" The GSHS only asks for the *average* number of drinks consumed on the days the student drank. If students *usually* only consume one or two drinks, any binge drinking episodes will not be captured. The impact of this on the binge variable in this project is that it is capturing only the heaviest drinkers in the population: those who are *consistently* drinking at a binge level. The greatest amount of harm stems from single binge drinking episodes, which is likely not being captured in this project.

Despite this, binge drinking within current drinkers ranged from about 4-5 percent in Ghana, Syria, and Mongolia to 25-35 percent in Kiribati and Argentina, respectively. In U.S. surveys, alcohol consumption among youth has been decreasing over the past decade, but the proportion of those who drink who are binge drinking has remained consistent. In other words, if young people drink, they are still likely to drink heavily. Additionally, recent surveys have attempted to capture binge intensity, or the actual number of drinks consumed during the binge episode (rather than using the 4/5+ cut point). An analysis of a combination of cohorts from the 2005 to 2011 Monitoring the Future surveys found that when asked to report the number of times they had 5 or more, 10 or more, and 15 or more drinks in a row in the past two weeks, 20.2 percent of high school seniors reported binge drinking, 10.5 percent reported 10 or more and 5.6 percent reported 15 or more.[139] Hingson and White have suggested that these episodes of greater binge intensity may be contributing to increases in hospitalizations among young people in the face of declining overall alcohol consumption.[138]

The hypotheses in Aim 2 were that alcohol consumption, as measured on two levels, would have a greater correlation with fighting and serious injury than no reported current drinking, and males would experience a greater prevalence of harm than females. Again, findings were overall in agreement with the hypotheses. As expected, a dose-response relationship to both outcomes was found compared to non-drinkers with increasing levels of consumption. The key finding in this aim was that an average of 30 percent of non-drinking students across countries reporting being in a fight compared to 52 percent of current non-binge drinkers and 56 percent of binge drinkers. Similarly, 44 percent of non-drinkers reported a serious injury, compared to 59 percent of current non-binge drinkers and 62 percent of binge drinkers. While adjusted odds ratios (AORs) of drinking patterns relative to non-drinkers generally fell within a similar range

across countries, a number of them stood out. In Ghana, binge drinkers had a 12.4 greater AOR than non-drinkers of past year fighting, in Belize the AOR was 5.8, and in Samoa the AOR was 6.6. Samoa had the greatest prevalence of fighting overall; however, 90 percent (95%CI: 79.0-95.1) of binge drinkers reported fighting. In other words, if you are drinking heavily in Samoa, you are going to end up in a fight. A similar story was seen for serious injury in Samoa, with almost 97 percent of binge drinkers reporting past year serious injury.

Male non-drinkers and current non-binge drinkers reported greater prevalence of past year fighting and injury than females non-drinkers and non-binge drinkers. Although not statistically significant, female binge drinkers reported greater prevalence of past year fighting in five countries and greater prevalence of past year serious injury in seven countries. What was the most important in the sex-stratified analyses was the finding that risk increased more dramatically in many countries for female drinkers than for males. In Honduras, 20 percent of females reported past year fighting versus 37 percent of males; however, only 15 percent of non-drinking females reported past year fighting; females who reported binge drinking had 7.1 greater odds of past year fighting (52.4 percent) than non-drinkers. In Cambodia, the overall rate of past year serious injury was 20 percent, the lowest of any country. For non-drinkers it was 20 percent for males and 16 percent for females. However, that increased to almost 53 percent in females who reported binge drinking at least once in the past 30 days (AOR: 6.5), which was also significantly higher than males (33.3 percent, AOR=2.0). While Cambodia reported low prevalence for both outcome variables at all levels of alcohol consumption among both males and females, 1 in 6 non-drinking females reported a serious injury compared to more than 1 in 2 binge drinking females.

They hypothesis in Aim 3 was that stricter alcohol policies would be correlated with lower prevalence of alcohol consumption, even after adjusting for a number of individual and country-level factors. Once again, findings overall supported the hypothesis, with a few notable exceptions that were explored in the discussion section of the third manuscript. Due to the limited number of countries available for study, a number of policies could not be evaluated, including blood alcohol content (BAC) and alcohol sales at gas stations–starting points for future research. Of the four policies evaluated, advertising restrictiveness is an area where LMICs could see great gains. Youth exposure to alcohol advertising has been shown to be associated with an increase in drinking in youth already drinking or an increased risk of initiating alcohol use.[94] Systematic reviews indicate that industry self-regulation of advertising content is poor, and violations are common[95]; however, the industry specifically uses the argument of the effectiveness of their self-regulation against any type of marketing restrictions.[172] Low- and middle-income countries may be in a better position to greatly restrict alcohol marketing in ways that the U.S. historically cannot or, in the lowest income countries, before the global alcohol industry begins significant investment and expansion with growing national income. This is also the overall message, that LMICs generally have weaker alcohol policy frameworks and should focus on strengthening effective policies as development ensues.

Public health implications

Low- and middle-income countries already shoulder a greater burden of disease and injury compared to HICs[3]; as development increases, alcohol consumption increases, leading to increases in alcohol-related harm. While HICs have a number of protective factors against alcohol-related harm, including stable health systems and greater access to mental health and addiction services, robust policy environments, and an ability to enforce policies, LMICs are

often lacking in all or most of these aspects. As noted above, few resources are put towards alcohol control in general, and LMICs may be open to industry involvement in drafting national policy statements in exchange for development dollars.[99] Industry involvement in policy development generally leads to the least effective policies, such as education, being promoted as the primary means of control. Best practices in limiting access by means of outlet density, limited hours and days of sales, and higher taxes are rarely included.

This project demonstrates that students in LMICs are consuming alcohol, many at dangerous levels, and that heavier alcohol consumption is positively correlated with the leading causes of morbidity and mortality in this age group. Females, while drinking less overall, may be drinking at more harmful levels than males or at least converging upon rates in males. And while females' consumption levels may not be significantly different than males, they are experiencing a steeper increase in risk of harm in the form of fighting and serious injury in a number of countries. At least a number of policies effective in reducing youth consumption and related harm that have been extensively studied in HICs, however, should be prioritized in policymaking in LMICs, especially at more restrictive levels.

Next steps

Low- and middle-income countries need their own alcohol surveillance, epidemiology, and case studies to more effectively inform programmatic and policy interventions. Other than basic demographics (age, sex, height, weight), none of the core modules of the GSHS are required; countries must only include any six of the nine of them, and the alcohol module was not completed by at least half of the countries. Due to the position of alcohol use as a leading risk factor for morbidity and mortality, the alcohol module should be required. Additionally, of the 94 countries completing a GSHS between 2003 and the latest results in 2015, only the

Philippines and two or three others have results for more than one iteration. In order to track trends in alcohol use and to evaluate and make any causal findings regarding policies and outcomes, more than one measurement is needed. Many national surveys of youth health risk behaviors in HICs are collected regularly such as the YRBS and National Survey on Drug Use and Health (NSDUH) in the US or the Health Behavior in School-aged Children (HSBC), conducted every four years in 48 countries across Europe and North America, and the European School Survey Project on Alcohol and Other Drugs (ESPAD). A similar survey is needed to provide longitudinal health risk data on young people in LMICs. Questions also should be standardized to emulate other national surveys, specifically to capture binge drinking more accurately. Expanded demographic questions such as family income and religion should be included to provide a more accurate picture of the risk and protective profiles of youth. Finally, the GSHS only captures students in school on a particular day; efforts should be made to capture the non-school attending population, which may be higher in LMICs than in HICs.

The WHO stresses cultural relevance in policymaking, but in PNG the draft national alcohol strategy included a national drinking age of 18, despite the fact that there were no state-sanctioned licenses and few people drive cars. Additional research is needed to identify factors such as these that could temper or promote policy effects. Accurately capturing enforcement of policies is an issue even in HICs, but future efforts should attempt to measure enforcement in LMICs.

A number of policies of interest, such as blood alcohol content (BAC), could not be evaluated due to the small number of countries, missing data, and lack of variability. For example, all 18 countries had the same BAC limits for youth and for the general population. Only one country reported zero tolerance; the rest were above the recommended threshold of

0.02, ranging from 0.05 to 0.08 to none. While the U.S. is in no position to criticize a national BAC of 0.08, a separate level for youth is an obvious point of intervention with demonstrated effectiveness, especially if it is 0.02 or zero tolerance. Efforts are needed to ensure a more complete database and to understand why some countries do not provide this data at all.

There is no one "correct" way to study the alcohol environment in LMICs; a combination of case studies, ecological analyses, case-control studies, and other methods are needed to create the body of knowledge required to guide programmatic and policy interventions. The great story here is that no one needs to start from scratch; the existing literature provides a solid foundation upon which to move forward.

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CURRICULUM VITAE

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EDUCATION

May 2018	**Doctor of Philosophy**, Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
May 2009	**Master of Public Health**, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
May 2009	**Certificate in Public Health Preparedness,** Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
August 2000	**Master of Physician Assistant**, Duquesne University, Pittsburgh, PA
May 1999	**Bachelor of Health Sciences**, Duquesne University, Pittsburgh, PA

PROFESSIONAL EXPERIENCE

THE CENTER ON ALCOHOL MARKETING AND YOUTH
Johns Hopkins Bloomberg School of Public Health, Baltimore, MD
Research Assistant, September 2013-present

- Analyze data and draft manuscripts independently as first author and in collaborations on projects including alcohol outlet density and zoning interventions, underage alcohol consumption and health risk factors, revenues attributable to the alcohol industry through underage drinking

Center Program Coordinator, March 2011-January 2013

- Managed two multiyear research and one multi-year surveillance grants including coordinating faculty and staff at four universities
- Managed resource allocation and revised budgets as necessary
- Planned project timelines and tracked deliverables.
- Assisted with outlining, drafting, and copyediting of research reports
- Drafted and reviewed grant proposals
- Researched and drafted policy memos
- Testified for state policymakers on alcohol advertising and youth exposure
- Developed and maintained CAMY website, Facebook and Twitter accounts

THE CDM GROUP, INC.
Bethesda, MD
STOP Act Deputy Project Manager, September 2009-March 2011

- Administered and coordinated the production of the annual Sober Truth on Preventing Underage Drinking (STOP) Report to Congress
- Researched, drafted, and edited the Report in collaboration with the Government Project Officers (GPO) at the Substance Abuse and Mental Health Services Administration (SAMHSA)
- Communicated and coordinated between multiple state alcohol-policy-related agencies, national alcohol policy organizations, and the GPOs at SAMHSA
- Collaborated with CDM staff to draft, edit, and submit grant proposals
- Coordinated, drafted, and reviewed materials for submission of packets to the Office of Management and Budget to comply with the Paperwork Reduction Act

ALCOHOL POLICY CONSULTATIONS
Felton, CA (worked remotely in D.C.)
Consultant, October 2009-March 2011

- Provided administrative support for meetings of the National Association for Preventing Underage Drinking (NAPUD) coalition's steering committee
- Acted as point of contact for NAPUD coalition member organizations
- Monitored state and federal legislative policy related to underage drinking
- Provided expertise and support in policy advocacy on requested topics
- Collaborated on website content design
- Researched and developed policy memos for alcohol related issues and underage drinking

BOSTON MEDICAL CENTER
Department of Plastic and Reconstructive Surgery, Boston, MA
Physician Assistant, September 2001-June 2008

- Non-clinical duties included: supervising departmental physician assistants; guest lecturing at Northeastern University's Physician Assistant program; mentoring-established first PA rotation in plastic surgery at BMC for Northeastern University; maintained department website; developed, directed, and marketed non-surgical, office-based procedure practice

PROFESSIONAL DEVELOPMENT

2015-current	Certified in Public Health
2000-2015	National Commission on Certification of Physician Assistants

AWARDS

2018	Public Health Practice Award
2013-2018	Health, Behavior & Society Departmental Scholarship
2015	Global Health Established Field Placement; San Jose, Costa Rica
2014	Health, Behavior & Society Doctoral Special Project Funding

PROFESSIONAL ACTIVITIES

2012-Present — American Public Health Association
- Member (2012-2018)
- Abstract reviewer—ATOD (2013-2016)
- Governing Council (2012-2015)

2009-Present — Maryland Public Health Association
- President (2016-current)
- Chair, Annual Conference Committee (2016-2018); Co-chair (2012)

2000-2009 — American Academy of Physician Assistants
- Fellow (2000-2009)
- House of Delegates alternate (2007)

2003-2008 — Association of Plastic Surgery Physician Assistants
- Treasurer (2004-2007)

ACADEMIC SERVICE

2013-Present — Forum on Alcohol Research and Advocacy (student group); Founding Chair (2013-2015)
2014-2015 — Health, Behavior & Society Student Organization Co-chair
2014-2015 — Health, Behavior & Society Curriculum Committee
2014 — Health, Behavior & Society Practice Committee

TEACHING EXPERIENCE

2013-2018 — **Teaching assistant**, Johns Hopkins Bloomberg School of Public Health

Course title: Current Issues in Public Health
- Led live interview discussions with invited lecturers, communicated with students, graded assignments; 11 terms (Edyth Schoenrich)

Course title: Media, Advocacy, and Public Health: Theory and Practice
- Facilitated small group work/discussions, graded assignments; 5 terms (David Jernigan)

Course title: Alcohol, Society and Health
- Lectured, developed course materials with course instructors, communicated with students, graded assignments; 1 term (Susan Baker & David Jernigan)

Course title: Foundations of Social Epidemiology
- Facilitated online and in-person discussions, graded assignments; 1 term (David Celentano & Amanda Lattimore)

PUBLICATIONS

Meisel PL, Sparks A, **Eck R**, Jernigan D. Baltimore City's landmark alcohol and tobacco billboard ban: An implementation case study. *Inj Prev*, 2015;21(1)63-7. doi: 10.1136/injuryprev-2014-041244.

Siegel M, DeJong W, Naimi TS, Fortunato EK, Albers AB, Heeren T, Rosenblum DL, Ross C, Ostroff J, Rodkin S, King C, Borzekowski DLG, Rimal R, Padon AA, **Eck RH**, Jernigan DH. Brand-specific consumption of alcohol among underage youth in the United States. *Alcohol Clin Exp Res,* 2013;37(7):1195-1203. doi: 10.1111/acer.12084.

PRESENTATIONS

Eck, R. (2018). A World Without Limits: The Maryland Experience. Alcohol Policy 2018 Advocates Training Seminar; Arlington, VA (invited speaker)

Eck, R., Jernigan, D. (2018). Patterns of Alcohol Consumption and Violence and Injury in Youth in Low- and Middle-Income Countries. Alcohol Policy 2018; Arlington, VA (poster)

Eck, R. (2018). Does Commerce Trump Public Health? National Alcohol Beverage Control Association Legal Symposium; Crystal City, VA (invited speaker)

Eck, R. (2017). Multi-Dimensional Climate Literacy and Civic Engagement: Supporting Healthy Communities. Health Policy Research Consortium Conference; Morgan State, Baltimore, MD (invited speaker)

Eck, R. Naimi, T. Jernigan, D. (2016). Binge Drinking and Associated Health Risks Among Underage Youth. American Public Health Association Annual Conference; Denver, CO (poster)

Eck, R., Naimi, T. Jernigan, D. (2016). Patterns of Alcohol Use and Harm Among Young Drinkers. Alcohol Policy 2016; Washington, DC (poster)

Cukier, S., **Eck, R**., Jernigan, D. (2013). Content Analysis of Alcohol Messages on Popular TV Shows. American Public Health Association Annual Conference; Boston, MA (poster)

Eck, R., Jernigan, D. (2013). Unwanted Profits to the Alcohol Industry From Underage Drinking. (oral)

Williams, C., **Eck, R**. (2013). Alcohol, Women, and Health in Papua New Guinea" Global Alcohol Policy Conference; Seoul, Korea (poster)

Eck, R. (2012). Monitoring the Marketing Practices of the Industry: From Traditional Media to the Wild West of the Digital Space Washington State Prevention Summit; Yakima, WA (invited speaker)

Meisel, P., Sparks, A., **Eck, R**., Jernigan, D. (2012). Baltimore Billboard Ban. American Public Health Association Annual Conference; San Francisco, CA (poster)

Eck, R. (2012). Alcohol Advertising and Youth: The CAMY Mission. Global Alcohol Policy Alliance Conference; Bangkok, Thailand (oral)

Eck, R. (2011). Digital Alcohol Marketing. OJJDP's Enforcing Underage Drinking Laws National Leadership Conference; Orlando, FL (invited speaker)

Eck, R., Mosher, J. (2010). Alcoholic Energy Drinks: A Dangerous Buzz. Alcohol Policy 15 Conference; Washington, DC (poster)

Eck, R. (2005). Wound Care: Post-flap Surgery. Boston Medical Center wound care conference; Boston, MA (invited speaker)

Eck, R. (2005). Sculptra: Assessment and Use in HIV Facial Lipoatrophy. Department of Infectious Disease, Boston Medical Center; Boston, MA (invited speaker)

MEDIA

Eck, R. (Nov. 2017). "Maryland should consider health and social costs of alcohol industry, not just economics." Baltimore Sun (op ed)

Eck, R., McLaughlin, T. (July 2017). "Harris ignores Ocean City wind power benefits." Delmarva Now (LTE)